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On the Editor's Bench

On My Bench

After last month's admission of workshop inactivity, I've managed to be a bit busier of late. As well as making further tripod modifications, I've made a laser telescope collimator using a nice little laser module. It works very well and showed that one of my mirrors was very badly out of alignment! As the picture shows it's at the 'working' stage rather than finished; my plan is to use it as a test piece for home anodising. I will follow the excellent advice given by Ramon Wilson in an article in our sister magazine, *Model Engineer*, last year. The module was one of several surplus items a forum member has given away. Apparently most of the others have found their way into centre finders.

My confessions of an interest in astronomy have encouraged a good half-dozen members of the forums to reveal a common interest. In a recent meeting I was sat by someone who saw



Saturn on my laptop – and it turned out he's into astrophotography too! In many ways astronomy is like hobby engineering – much interesting and good work is done by amateurs, there is a great deal of inventiveness and ingenuity and the number of people involved has mushroomed in recent years due to an abundance of good quality, affordable kit coming out of China.

Sell Out

I'm afraid that a fair number of readers have been disappointed by being unable to get hold of a copy of *25 Years of Model Engineers' Workshop*. I'm afraid that MyHobbyStore have run out of copies and the demand is such that the newstrade don't want to send us any copies back. This also means that it's difficult to find copies in high street stores, although a few people have reported seeing small numbers of copies in WH Smiths, particularly in North Wales and Cornwall – is there a Celtic connection?

If you are unable to get a paper copy, you can order a digital copy by going to www.model-engineer.co.uk and clicking on the picture of the special.

Cover Shot

I'd like to thank Roger Walton for permission to use his wonderful picture of Paul Windross testing his flash-steam hydroplane in his garden. Paul has a number of UK motorcycle speed records under his belt, but hasn't rested on his laurels as he now takes part in an annual battle for the world flash steam hydroplane speed records. Go to the forum and search for the thread *Two fast steam boats one doing its fastest speed* where there was some disappointment with a speed of only

about 128mph... I'm afraid we don't have an article about Paul's workshop activities to follow up with, but I shall see if I can persuade him to come up with something.

Be My Frankenstein

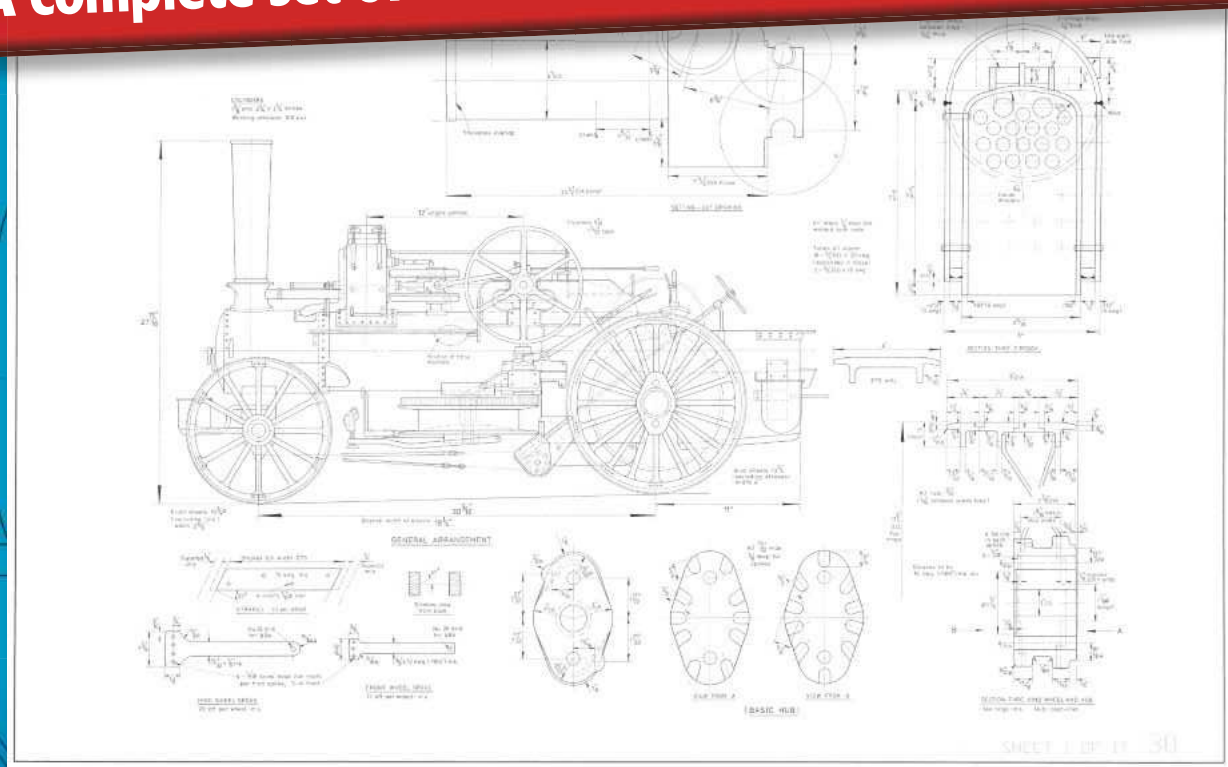
Austin Hughes cut up a 50-year-old Unimat lathe to make a grinding machine. By no means a rarity, but well made, many of us might have second thoughts before starting on the butchery of a near-mint Unimat! But this has proven a very practical route to a useful tool for Austin. On the forums, there has been some discussion of an unusual repetition tool of uncertain use. It's unlikely ever to find a home in a museum but perhaps it's conversion to some sort of shop-made machine, like a grinder, is actually the most fitting fate, rather than rusting away in the corner of a junk shop, or worse.

This has got me wondering, what sort of terrible deeds have readers done in their own workshops? My own tool grinder has what used to be a bench grinder suspended on a piece of scaffold pole! I suspect that almost every workshop contains at least one Frankenstein Tool. If you have such a machine hidden away under your bench, why not send me a photo and a short description for *Scribe a Line*, or even write a short article?

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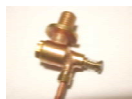
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Contents

8 UNIMAT REBORN AS A GRINDING REST

Austin Hughes takes a dose of pragmatism and repurposes a lathe.

12 MAKING A CANTILEVER TOOL FOR SQUARE TAPPING

Mogens Kilde returns with another well-executed design.

20 LATHE HEADSTOCK EXTENSION

Cameron McKeown concludes the story of his massive accessory.

24 THE POTTS SPINDLE

Stub Mandrel looks at a classic bit of workshop equipment.

25 A MORSE TAPER REMOVAL CLAMP

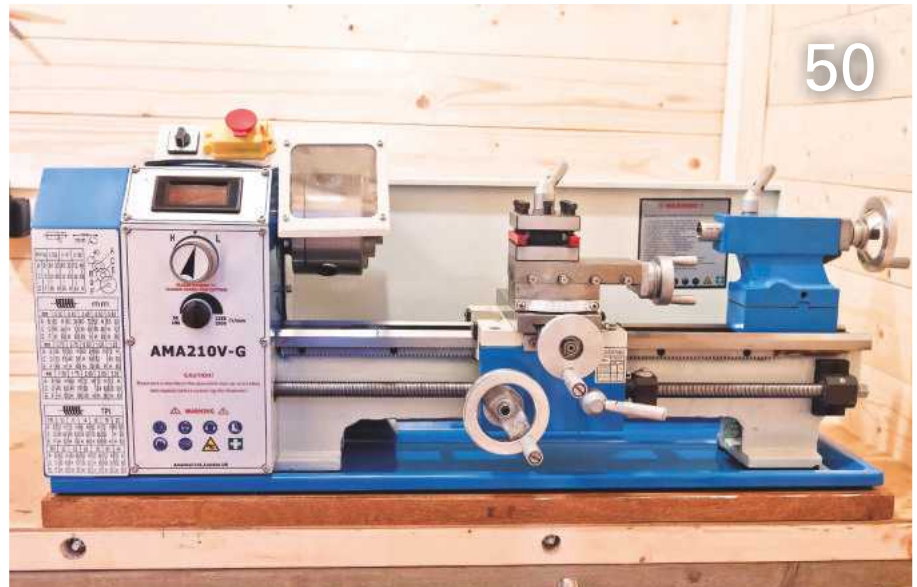
Using a mallet to remove recalcitrant tapers didn't appeal to Paul Lousick.

28 PACKING BLOCKS

Make Paul Tiney's simple but useful aids to clamping in a weekend.

30 HARROGATE SHOW 2015

The Editor reports on some of the tooling at this year's Harrogate Show.



32 WHAT IS SUGRU?

Find out about this useful product.

34 ASSORTED ADEPTS

At the Spalding Show no less than three of these little vintage lathes were on display, reports Howard Lewis.

36 A TABLE LENGTH MILLING VICE

David Piddington continues his step-by-step guide.

42 THE MILLER'S TALE

Lend an ear to story of Ian Strickland's Trident Mill restoration.

50 ONE MAN AND HIS LATHE

Howard Winwood explains why he chose the Amadeal AMA210VG.

56 AN ALTERNATIVE HANDLE FOR A MACHINE VICE

Ken Hall applies a little thought to a useful upgrade.

58 MILL SPINDLE SLOW SPEED FRICTION DRIVE

Even if you don't need Malcolm Parker-Lisberg's slow drive, you will be interested in his casting methods.

63 REVIEW - WARCO WM250V LATHE

Dave Fenner give us the low-down on a this new offering from Warco.

69 CHALLENGE AND RESPONSE

Another perspective following a recent OMAHL article, from Stuart Walker.

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Coming up...

in the September issue



SPIRIT OF HOBBY ENGINEERING

The results of our 25th Anniversary Workshop Photography Competition. Will this entry from Brian Moseley make the cut?

PLUS Jason Ballamy takes a closer look at the EMG-12 endmill resharpener's performance, Stan Nesbitt describes a home-build power hacksaw and Ted Jolliffe makes a tool fit for Thor!

Regulars

- 3 ON THE EDITOR'S BENCH**
What's happening in the editorial workshop?
- 19 READERS' TIPS**
Need a cheap die grinder? Look no further.
- 46 ON THE WIRE**
A book, a mill and a fistful of adhesives!
- 54 SCRIBE A LINE**
More of your letters and feedback.
- 62 READERS' FREE ADVERTS**
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ON THE COVER



Flaming June? Last month record-breaker Paul Windross decided it's better to test his flash steam hydroplane outside the workshop. Photograph: Roger Walton.



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Health and Safety in Engineering Workshops

The topic of 'health and safety' is not always the most popular with many hobby engineers who can view any advice on how to manage their workshops as an intrusion. Nonetheless, regular forum discussions reveal that, from time to time, there are some close calls and unpleasant accidents in our workshops. It harms no-one to make sound advice on workshop safety readily available, particularly to beginners who are in a position to learn the habits of safe working. This article links to the HSE's latest advice.



Some of the other live topics on the forum include:

- > What's Going On with this Mill?
- > Repetition lathe or screw slotting machine? Can you help identify this mystery tool?
- > Polymorph Half Nut – could this re-mouldable plastic be suitable for making half nuts using the leadscrew as a pattern?
- > Price of Aluminium – what's a fair price to pay for a big sheet of aluminium alloy?
- > Aircraft General Discussion – why are our readers so keen to talk about aircraft?
- > QCTP Broaching Tool – Ed Dufnner explains his neat toolpost mounted broaching device.

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Unimat Reborn as a Grinding Rest

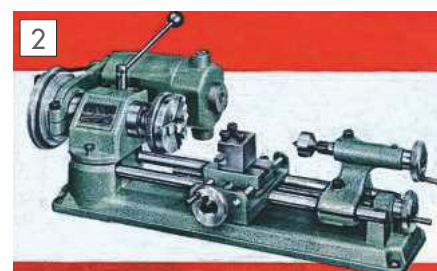


Could you chop up a fifty-year old lathe for parts? Austin Hughes shows his metal!

When my young grandson was asked 'what does your grandad do?', he thought for a minute before replying 'he's a retired mender'. My pleasure at hearing this description must have been obvious, for a few months later I received a birthday present that now adorns the door to my workshop (**photo 1**). I've always liked mending or adapting things, which undoubtedly explains why I enjoy making aids for disabled people as a REMAP volunteer.



Workshop door (with railway link).



Unimat lathe, pictured on 1960 brochure. The length of the bed is 35cm.

Like many, I seldom throw things away, and for most of my life I convinced myself that the Selecta Unimat lathe (**photo 2**) that I was given as a seventeen-year old would ultimately show its worth. My kind dad was right in thinking it would be just the thing for a lad intent on scratchbuilding 4mm locos, given its versatility: the headstock and motor was removable for re-mounting on a pillar for drilling and vertical milling. But he had overlooked that fact that it was almost time for me to leave home, so very soon a student apprenticeship, higher education, career, marriage and a family meant that modelling took a back seat and the lathe remained unused in its oak box for over half a century.

On retirement, I'd established a decent workshop with a Boxford lathe and Sieg mill, but clearly what it lacked was a set-up for grinding tools, so I sought guidance from Harold Hall's book *Tool and Cutter Sharpening*, which proved to be invaluable. His design for an advanced grinding rest immediately appealed: in essence it comprises a two-axis table mounted atop a tilting arm that also provides modest vertical adjustment. I felt that making one was within my capability, but I did as usual and began to wonder if there was anything I already had that could be adapted instead.

Even before I had opened the oak box I had a mental picture of the saddle and cross-slide of the Unimat, and knew it

would be just the job: small, with more than enough travel in both axes, and not too bulky. But more than that, amongst the accessories was a slotted milling table that would be ideal for the top on which items to be sharpened are positioned. All that was needed was to mount the table on a tilting/rocking base fixed to the table slide, and provide some vertical adjustment. And so it turned out, eventually, see **photo 3**.

All very well, but that meant butchering the lathe, and rendering it impotent before it had ever turned in earnest. But then again, why not – it had never been used, there was no foreseeable application in prospect; and we don't know for how long we will be around, so why hesitate? A



Completed grinding rest.

mixture of guilt and sentimentality, I suppose. But enthusiasm soon took over, and thanks to the modular construction of the Unimat it was dismantled quickly and my machine hacksaw cut through the cast iron bed in no time. After such surgery, there was no turning back, but what about the other leftover 'organs' (**photo 4**)?

Well, the headstock contained an excellent quill/spindle with drive pulleys which eventually became a toolpost grinder that can also be used on the mill (**photo 5**); the self-centring chuck mounts on a stub arbor and is useful in the tailstock of my Boxford; and the other bits are still awaiting their new roles.

Shortening the bed

Having cut the cast iron base in two, it was necessary to shorten the two cylindrical rails on which the saddle runs. They were easier to cut than I feared, but would clearly need to be supported at the cut-off ends, and, most importantly, be spaced correctly, otherwise the saddle would become jammed.

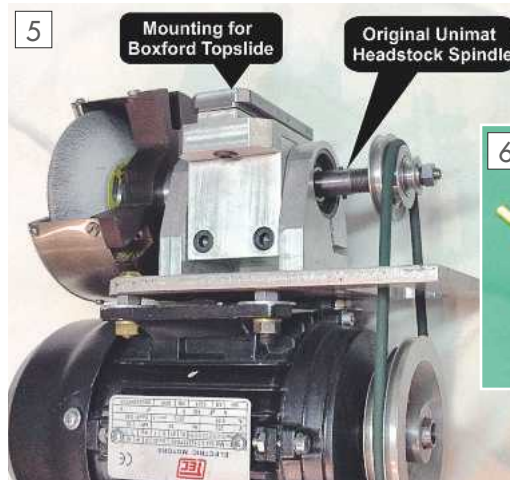
This was where the tailstock made its contribution, by sacrificing the lower half of its pinch-bolt mounting (just visible in photo 2). This cast iron piece had two semi-circular recesses at the correct spacing for the rails, and was therefore ideal for the top section of a new pedestal that sits on a flat milled across the bed. (It was also shortened longitudinally in order to maximise the travel of the saddle, though this has never proved necessary.) The bottom part of the pedestal is a rectangular block of mild steel machined to bring the rails to the correct height above the bed, the rails being secured by cap screws tapped into the base. The saddle leadscrew was shortened to match the rails, and because the tailstock clamp already had a clearance hole for the leadscrew, no further modification was needed. It was a pleasant surprise that the saddle and cross slide both worked beautifully first time – I don't usually have immediate success!

Tilting and rocking table

In normal operation, the rest sits facing the grinding wheel, so that the cross slide handle is directly in front of the operator, and the saddle handwheel is to the right. For the purpose of the following



Some of the leftovers....



The toolpost grinder.



Tilting mechanism (on the left) and rocking (right).

discussion, if we imagine an upright mounted on the table, rotation of the table that causes the upright to lean to the left or right is termed tilt, while rotation that causes the upright to lean forward or backward is termed rock. (I guess readers with an aeronautical background may prefer to use roll and pitch, but I prefer the more everyday terms!).

The tilt facility (**photo 6**, left) is mounted directly onto the Unimat tool post using the existing T-slot. It is made from solid aluminium, the steel shaft that supports the rocking arm being held at the desired angle via a split clamp. I find that it is seldom necessary to set this angle other than by eye, so there is no provision for measurement.

The clamping handle has an unusually long shank to ensure that it does not foul the table. Needless to say, it started life much shorter, and was okay for the first few straightforward grinding sessions, but before long an irregular operation prompted a rethink.

I've made lots of split clamps, always made up as I go along, and most of them work fine, but I still can't guarantee success every time. I prefer the clamping action to be via a screw that tightens into a tapped hole in one side of the clamp, rather than having a captive projecting screw onto which a nut is tightened, probably because it isn't necessary to secure the screw, but I'm not sure if it makes any real difference in operation. What I do know is that the hole must not be bigger than the mating shaft: a tightish sliding fit prior to cutting the slit is ideal,

not least because when the slit is made, stress relief can occur and then the 'arms' spring apart, and thus require extra pressure via the screw to tighten down. Sometimes I start with too much 'meat' in the arms, making it difficult or impossible to apply enough clamping pressure to prevent rotation. In that case, the arms can be relieved at the point of maximum bending stress, as shown by the circular cut-outs in the 'rock' pinch bolt shown in photo 6.

Provision for rocking the table is via a hinged joint rigidly mounted on the tilt shaft, as shown (right) in photo 6. The table is again locked at the desired angle by means of a clamping action, but in this case the hinged member is located between the arms of the split clamp. The screw again needs a long shank in order not to foul the table.

The original milling table has four fixing holes forming a square, two of which are used to fasten the table to its hinge. There are therefore four possible positions of the table relative to the hinge: two of them result in the slots in the table being parallel to the plane of the grinding wheel, and the other two set it perpendicular to the wheel. For most grinding, the slots lie parallel to the face of the wheel.

Exploiting the slotted table

Until I read Harold Hall's book, I had not realised the importance of grinding on the corner of the wheel, so adopting his approach has been a revelation and I am delighted with the results.

The grinding rest(s) described in the book provide a rectangular table on which the item to be sharpened is positioned, one edge of the table being parallel to the wheel. The item (a lathe tool, say) does not sit directly on the table however, but is carried in a purpose built holder (HH calls them accessories) that in turn sits on a flat base plate. The tool holder pivots on the base plate, which can slide on the table. A typical holder for square tooling is shown in **photo 7**. The angle of the holder relative to the baseplate determines the angle (e.g. rake or clearance) of the ground face.

A key feature of the table is that it has a guide rail or fence against which the baseplate of the tool carrier slides to and fro when grinding. The angle of the fence relative to the wheel has to be adjustable, though for most operations the angle of the fence relative to the edge of the table will only be a degree or two – just sufficient for the tool to advance past the corner of the wheel during grinding. An end stop is also required, particularly when undertaking plunge grinding, where the tool is advanced directly into the outside edge of the wheel.

The versatility of the slotted table for providing a widely adjustable fence should be clear from **photo 8**.

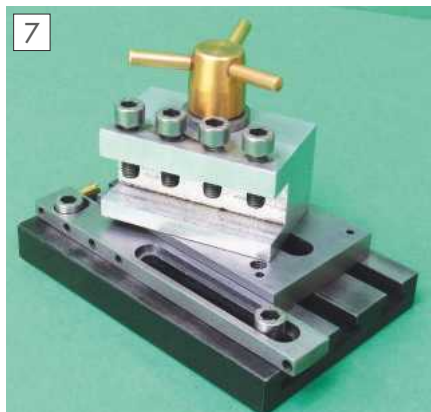
The fence is made from a piece of mild steel with two slots, both counter-bored to reduce the projection of the socket cap screws that fasten the fence: if the screw heads stick up too far, they foul the tool holder sitting on its baseplate.

The short perpendicular slot near the end of the fence allows for easy setting of the one or two degrees of clearance angle, while the long slot can in theory provide for a wide range of angles by moving the T nut into a different slot. In practice, it is mostly used to set the fence more or less parallel to the slots.

The small brass end-stop can be screwed in any of four positions, on either edge of the fence. (I forgot to drill and tap right through at first, not realising my mistake until I needed to grind on the opposite corner of the wheel, only to find that the end stop was then on the wrong side.)

Mounting the rest

When the rest was nearing completion, I invested in an upmarket bench grinder. I already had a cheaper model that had



Holder for square shank tool in typical position on table.

coarse and green grit wheels, but HH's book had convinced me of the need for a saucer shaped wheel for regrounding cutters.

I had recently inherited a pre-war sewing machine mounted on a sturdy cabinet and the latter was clearly ideal as the basis of a 'grinding station' with the machines on top and all accessories stored beneath. Like all of my machines, I wanted to be able to move it about, so wheels were added, and a surplus piece of 40mm hardwood worktop was fitted to make a sturdy benchtop for both grinders. The newer one (to be used with the new rest) had to be raised to limit overhang, as shown in **photo 9**, and this determined the height at which the rest had to sit.

A piece of 100mm channel iron turned out to be suitable (see photo 3), so the surfaces were flycut square on the mill to make fitting easy. Given the desirability of some vertical adjustment, the Unimat base was fixed to the channel with three screw adjusters. One screw is centred at one end, while at the other end there are two, one of which is visible in photo 3, which also shows how the sides of the channel were relieved to accommodate the adjusters.

By this stage things were beginning to look top heavy, but fortunately the weight is concentrated at the bottom and my worries were groundless. Nevertheless, the rest has to be secured to the bench top, and this is done via two jacking clamps that engage with the aluminium



Slotted table fitted with adjustable fence and end stop.

angle that runs round the edge of the top. This arrangement has proved ideal for coarse lateral positioning of the rest.

In use

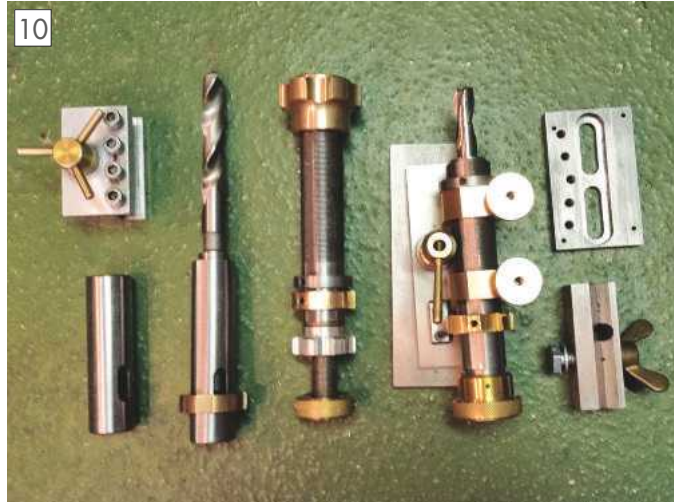
Dust is a problem, so rags are draped over the slides and air-dusting is frequent. The pitch of the lead screws is 1mm, so it is easy to put on fine cuts (1 thou corresponding to 9 degrees rotation of the hand wheel).

With lathe tools, at least, it seems that the best results are obtained when the axis of the tool points at the centre of the wheel. Large tools with thick shanks have bigger holders and sit higher above the table than small ones, so one might expect to have to alter the three vertical adjusting screws to accommodate the difference. However, I find it much easier to use a combination of the rocking facility and the cross feed to ensure correct orientation of the tool. The fact that the angle with respect to the benchtop varies clearly doesn't matter as long as the tool points to the centre of the wheel.

Flushed with early success with lathe tools, I have now made several more accessories for cutter sharpening, all based on the Harold Hall book, and am well pleased (**photo 10**). My most recent project is a much enlarged version of the well-known 'Picador' jig for sharpening drills up to 30mm: I'm not clear why it works so well, but the results speak for themselves. ■



Grinding station, showing the rest clamped to the aluminium angle on the cabinet top.



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Making a cantilever tool for square tapping

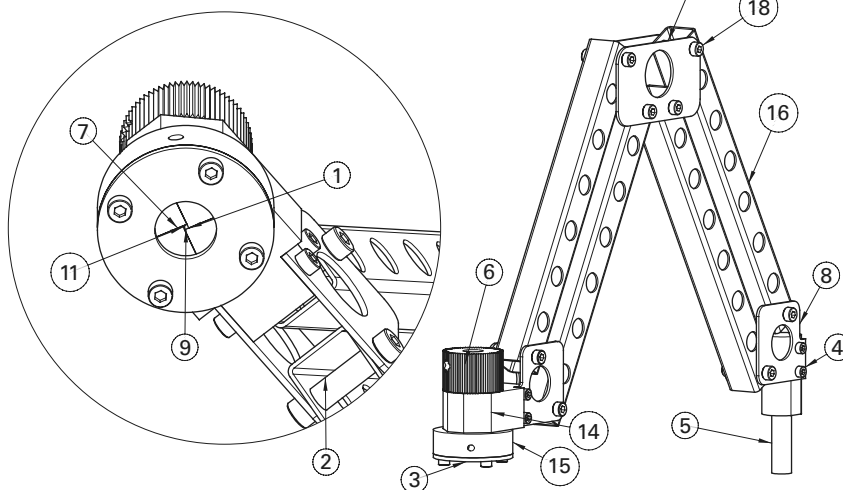


This article will describe how to build a compact tool that will ensure that you achieve a thread that is square to the work piece, both small items as well as larger ones. A CAD model of the complete tool is shown in **photo 1**. The idea is to hold the tapping tool in a self centring chuck and this chuck again is held in parallel arms thereby ensuring a constant alignment with a horizontal plane at any position of the tool.

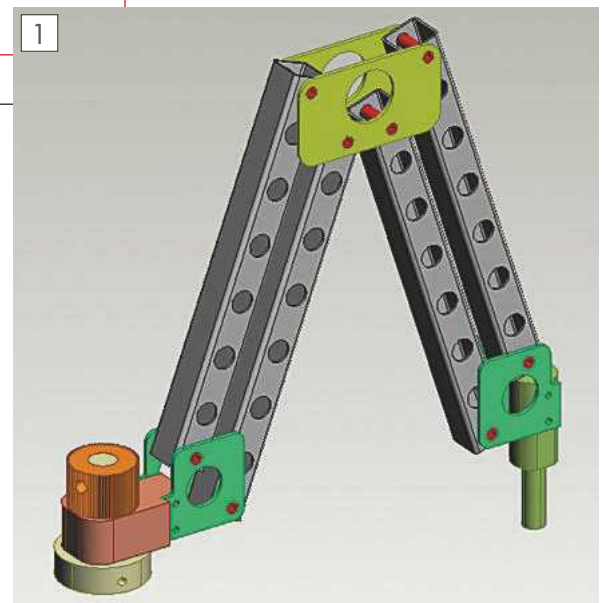
Mogens Kilde describes an unusual tool for accurately tapping holes that includes a neat self-centring mechanism.

Fig. 1

Component List			
ID	Qty	Name	Part no.
1	1	Jaw 2	1008/05
2	8	Shaft	1008/13
3	1	Collet cover	1008/14
4	12	M3 x 8 soc. head screw	-
5	1	Pivot rod	1008/12
6	1	Thumb nut	1008/11
7	1	Jaw 1	1008/01
8	4	Plate no.1	1008/10
9	1	Jaw 4	1008/08
10	1	Collet spindle (see dwg.1008/20)	1008/03
11	1	Jaw 3	1008/06
12	1	M6 x 6 sock. head screw	-
14	1	Collet bracket	1008/02
15	1	Tap collet housing	1008/04
16	4	Parallel arm	1008/07
17	2	Centre plate	1008/09
18	16	M4 x 10 soc. head screw	-



Tool Assembly



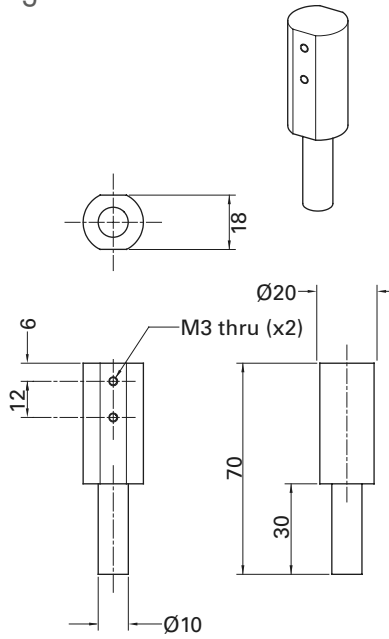
To make sure you can follow this project, please make reference to the general arrangement (**fig. 1**) all the way through my description. The first part I made was the pivoting shaft (**fig. 2**), this shaft will support the whole tool. I made the shaft from free machining steel.

First the work piece was cut a little over length from a 20mm diameter bar (**photo 2**) and then faced in the lathe to final length according to the drawing, next the 10mm shank was turned and all edges broken with a file, then the part was placed in the mill and the 18mm flat face, as indicated in the drawing, was made (**photo 3**); be careful with the dimension because if it is made under the width of the tool's parallel arms, the tool will jam when in use.

Finally the M3 thread was made, holding the work piece and the thread tap in the mill, to ensure that the tapping will be square (**photo 4**). The finished part can be seen in **photo 5**.

The next parts to make were the four pieces of plate number 1 (**fig. 3**). Two of these plates will hold the entire tool onto the pivot shaft and the other two will hold the front bracket for the thread collet housing. The plates are made from 1.5mm aluminium sheet, as you want to keep the weight down as much as possible.

Fig. 2



Pivot Rod

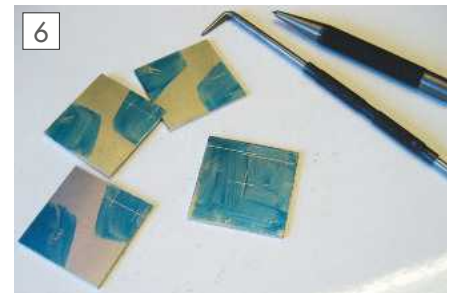
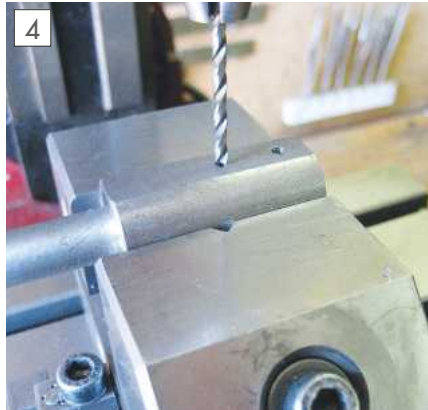
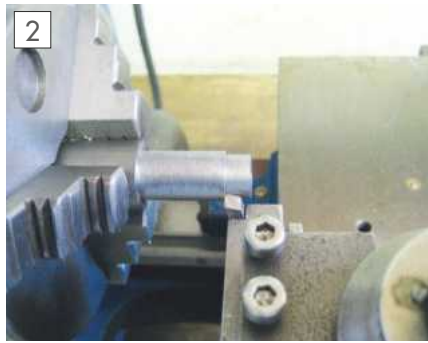


Fig. 3

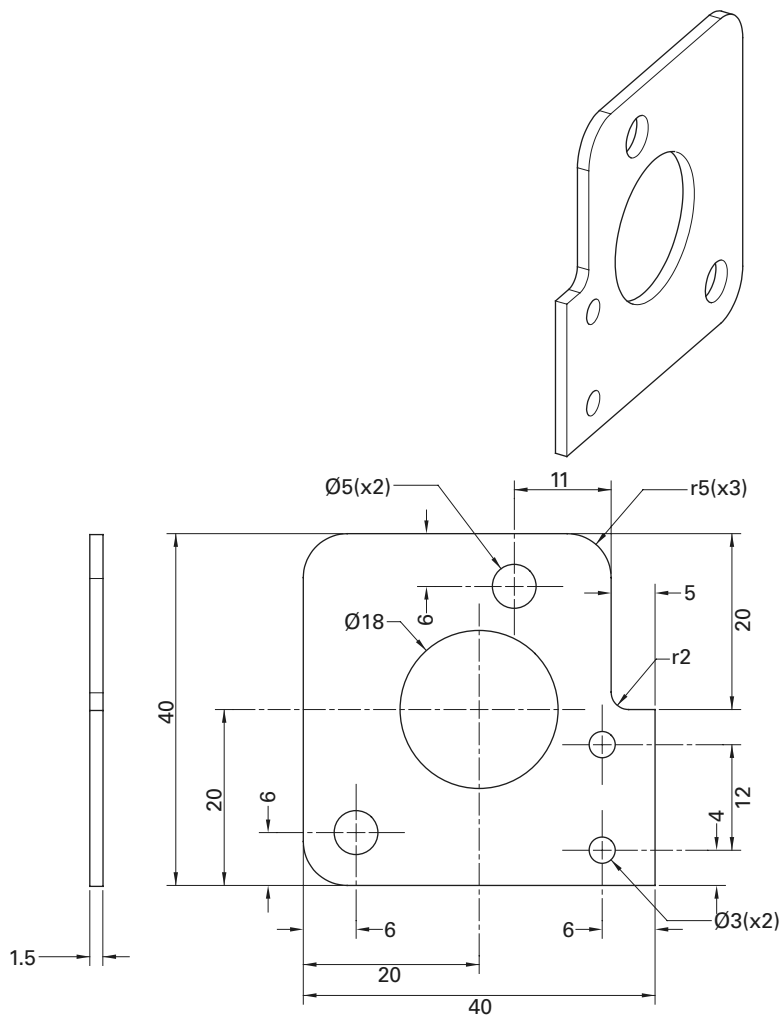


Plate No.1

The first job was to cut blanks to their outer dimensions according to the drawing (**photo 6**). Next I marked out the position of holes and radiuses on one of the blanks, also I marked out the position of the 3mm holes on the other four plates.

The 3mm holes were drilled in each plate (**photo 7**), and I could now hold the four sheet metal parts together in these holes, thus ensuring a similar position of the rest of the holes in the part. To ensure a correct parallel motion of the tool it is very important that the position of all holes is identical on all plates (**photo 8**).

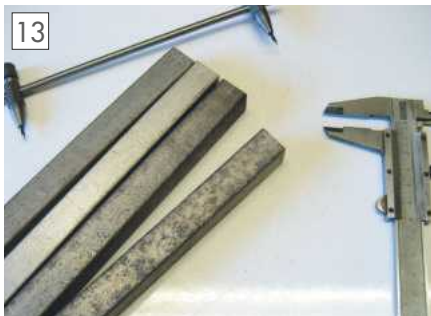
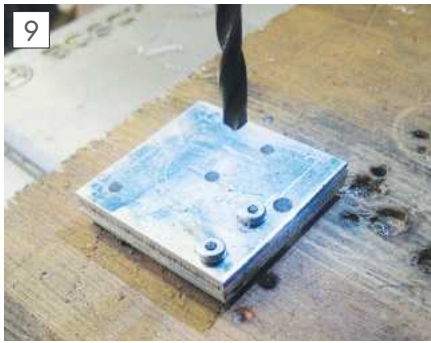
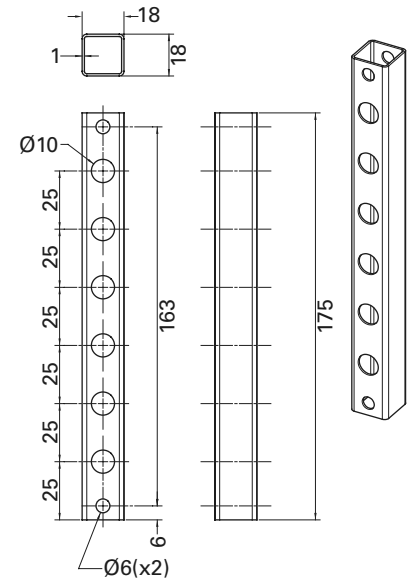


Fig. 4



Parallel Arm

Next I drilled the two 5mm holes (**photo 9**). In the milling machine I finally made the 18mm centre hole, using my boring tool (**photo 10**). After deburring and a finishing grinding with emery cloth, two of the plates were ready to be assembled to the pivot rod (**photos 11 & 12**). The other two plates will be used later in the project.

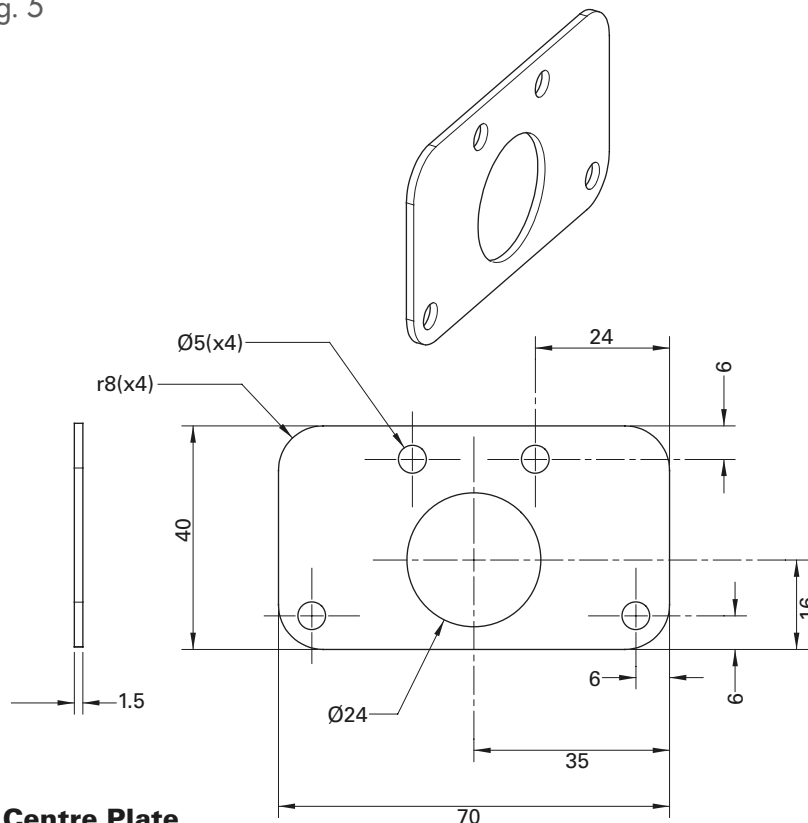
The next parts I made were the four parallel arms (**fig. 4**). The parallel arms were made from some 18x18x1mm aluminium profile that I got from the centre rod of an antenna that was 'killed' when information technologies went from aerial transmission to fibre optics (**photo 13**).

The arms were first cut to length according to the drawing. Next the two Ø5 holes were marked out, drilled and reamed on all parts, again the dimension is very critical and it is important to make the marks from one end of the work piece (**photo 14**). If you mark the position of the two holes from each end of the work piece, you risk building in an error from the cutting tolerance, so do mark out the positions from one end.

Next the set of 10mm holes were marked out and drilled on all parts, no critical dimensions here as these holes are only (but not unimportantly) to make the arms lighter so the finished tool will operate smoothly (**photo 15**).

The profiles were lastly brushed with a wire brush to remove the rust from the previous life on the roof top (**photo 16**). The next parts to be made were the two centre plates (**fig. 5**).

Fig. 5



Centre Plate



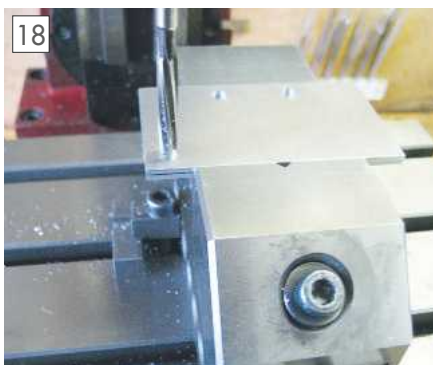
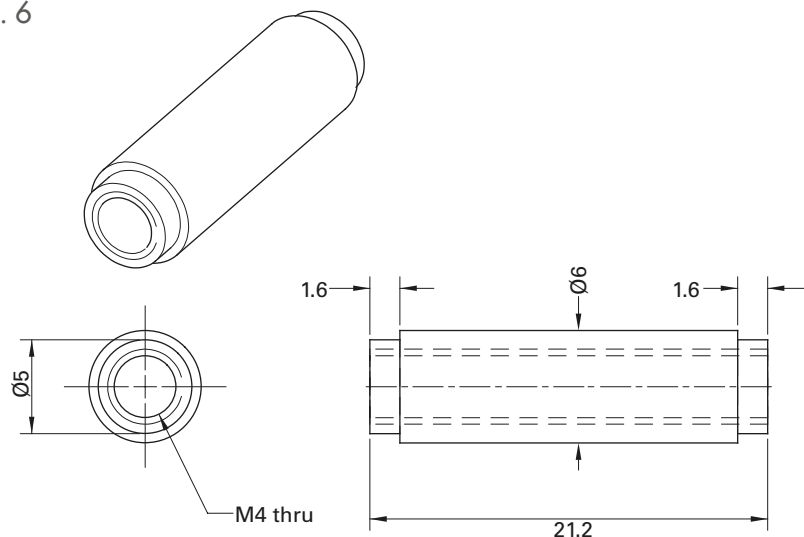
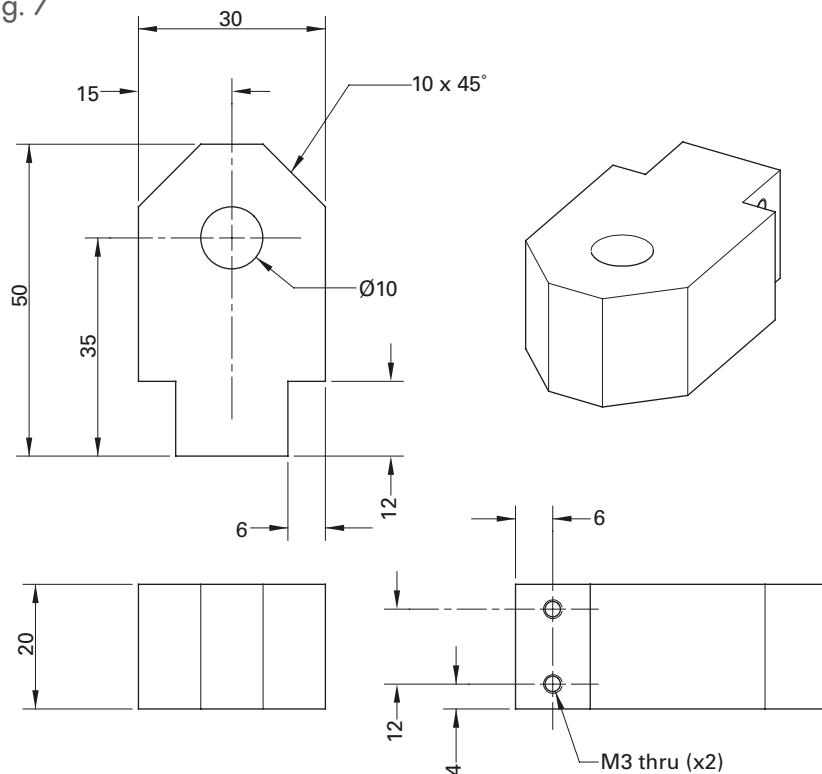


Fig. 6



Shaft

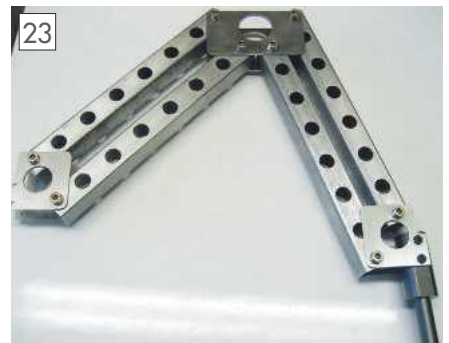
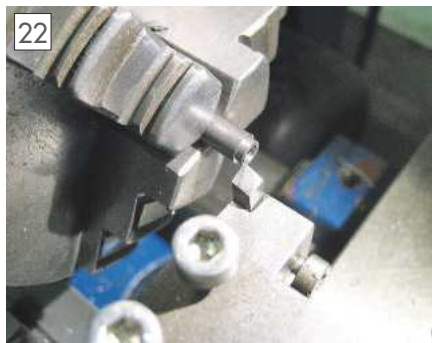
Fig. 7



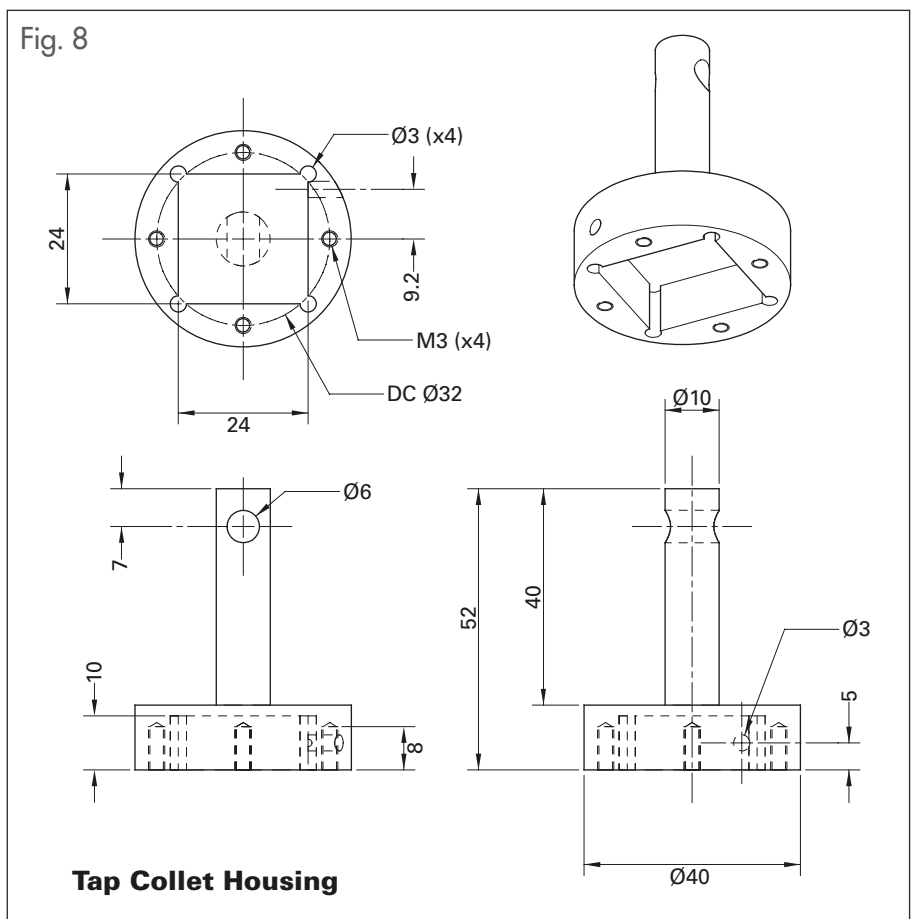
Collet Bracket

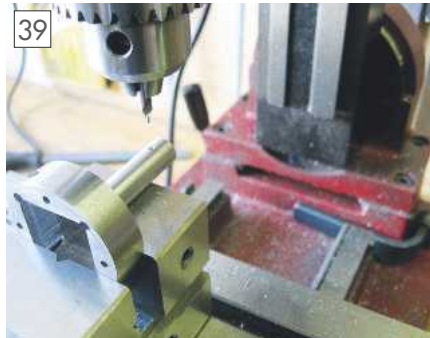
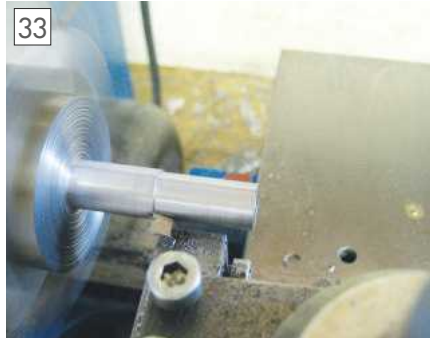
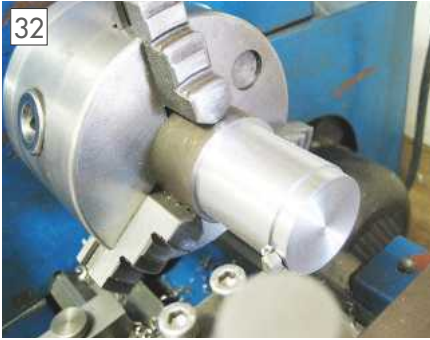
The plates (**photo 17**) were made from 1.5mm aluminium and first job I did was to cut blanks a little oversize according to the drawing, the blanks were milled to their final outer dimensions, this was done with both sheets held together, this way you can hold the blanks in the mill to produce all the holes in both plates at the same time (**photo 18**). The 5mm holes were drilled and reamed in the mill and to finish up the parts the centre 24mm hole was made using a drill first and finally the boring tool (**photo 19**). After marking the corner radiuses and making these with a file I lastly finished the parts surface with emery cloth.

The next set of parts to make were the shafts that joints plates and arms together. The shafts (**fig. 6**) were made from 6mm diameter free machining steel. First I cut bars a little over size (**photo 20**). The final length was turned on all of them in the lathe, the next operation was the drilling and tapping of the M4 thread through the entire part (**photo 21**), finally the 5mm diameter shoulder was turned (**photo 22**). With all shafts made, it was time to do the next assembly of the tool. The tool is beginning to look as intended in the design (**photo 23**). Next part I made was the bracket for the tap collet (**fig. 7**).



This part is made from aluminium (**photo 24**). After cutting a blank a bit oversized the outer dimensions were made in the mill using a fly cutter (**photo 25**). Next the 12 x 6mm section of the part was made with a 2-flute end mill (**photo 26**). Now the part was turned over and the two M3 holes were drilled and tapped (**photo 27**). The 10mm hole that will work as bearing to the collet for the tapping tool was drilled (**photo 28**). Again the part was turned over in the vice and using a protractor, the parts were aligned according to the angle shown in the





drawing, and the 10mm x 45° chamfer was made using the fly cutter once more (**photos 29 & 30**). The bracket was attached to the front end of the tool (**photo 31**).

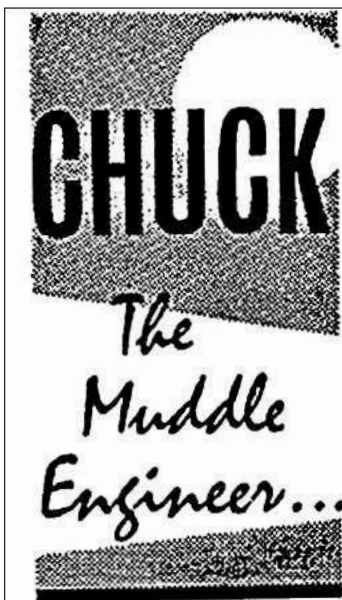
The next part I made was the housing of the tap collet (**fig. 8**). This part is made from Ø40mm mild steel bar. First a billet was cut a little longer than the finished length and the work piece was faced to final length in the lathe (**photo 32**). Next it was time to make some metal chips and a

lot of them it was, as I turned the 10mm shank of the part (**photo 33**). The part was turned over in the chuck and I made a 23mm holed boring 10mm deep into the part, this would ensure that the milling operation later would be less tedious (**photo 34**). Now the part was placed in the vice on the milling machine and the four 3mm holes, 10mm deep, representing the corner of the 24 x 24mm cut out, were drilled (**photo 35**). Next the four 8mm

deep M3 holes were drilled (**photo 36**) and the square hole 10mm deep was now milled step by step (**photo 37**).

The part was turned over in the vice and the 3mm hole in the side of the collet made using an end mill (**photo 38**). Finally the Ø6mm hole in the collet shank was drilled and the part was finished (**photos 39 & 40**).

To be continued...



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Readers' Tips

WIN
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**TIP OF
THE MONTH
WINNER!**

This month's winning tip is from Andrew Lengert, who wins £30 of Chester gift vouchers for his tip for his improvised die grinder.

Angle Grinder to Die Grinder

I think your readers may be interested in my latest project, which is a die grinder I modified from an angle grinder. I've always had a need for a die grinder but found the cost prohibitive. I bought one from China on eBay, fair enough for £30 it works, but at only 270 watts I don't push it too much. So I thought why not modify an angle grinder - 710 watts much better power, only problem I had it needs a speed controller, a heavy duty light dimmer switch works fine, homebrewed version in photo. I checked the output



speed & found my tachometer locked up at 20,000 rpm, so a need for speed control is essential. It possibly runs at 40,000 rpm or more full speed. I can't give sizes as this was literally made in a weekend, the collet is modified from an air grinder, it also needed ventilation holes at front and two sturdy bearings at front of housing. Works fine, nuff said.

Andrew Lengert

This month's first runner up is John Smith, despite giving us the brush-off He wins an Edge Technology lathe tool setting gauge.

Hog-Hair-Heaven

The FLAT-SECTION hog-hair artists' brushes sold cheaply by some 'remainder' bookshops and market stalls are excellent for cleaning swarf from awkward corners and spaces of machine tools. Use them straight, as they come, or bend the ferrules using pliers or vice to produce a 'rake-shaped' brush-head.

John R Smith



We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for each month's 'Top Tip'.

Email your workshop tips to **neil.wyatt@mytimemedia.com** marking them 'Readers Tips', and you could be a winner. Try to keep your tip to no more than 400 words and a picture or drawing. **Don't forget to include your address!** Every month we will choose a selection for publication and the one chosen as **Tip of the Month** will **win £30** in gift vouchers from Chester Machine Tools. Visit **www.chesterhobbystore.com** to plan how to spend yours!

The second runner up is Luis Petersen in Denmark, who wins a digital depth gauge.

Heading Please

I often have some awkward angles/pieces to cut on my cheap bandsaw.

It's very easy to cut some threaded holes in the 'vice' and use clamps to hold down material. A simple and cheap solution.

I'm not a beginner in engineering/machining but every so often the simple solutions are evasive. Keep up the reader's tips page as a regular item.

Luis Petersen, Denmark



CHESTER MACHINE TOOLS

No more than one prize with a value of £30 will be given each month. By entering you agree your entry can be freely published and republished MyTimeMedia on paper or electronically and may be edited before appearing. Unpublished tips may be carried forward to future months. You will be acknowledged as the author of the tip. There is no guarantee that any entry will be published and if no publishable tips are received a prize will not be awarded. The decision of the editor is final.

Lathe Headstock Extension

Part 3



Do you need a 500mm chuck? Cameron McKeown pushed his equipment to the limit, giving him the capacity to build a 6-inch traction engine.



It's something that all of us have been guilty of at one time or another – machine abuse! Many of us push our home workshop equipment to do the things they were never designed for, or ever thought capable of doing. How many times have we wished we had just that little bit more swing, saddle travel or extra length to a milling table? Over the years I have seen some amazing out of the box thinking in both the home and professional workshops to gain just that little bit more capacity to get the job done in house. This article describes the design concept and manufacture of a headstock extension to increase the swing of my lathe (**left**).



The milling machine turret head support.

Manufacturing the milling machine risers

Now that I had the capacity to machine components to a larger diameter it was time to actually make the items I had originally aimed this project at, the milling machine risers. The first riser I wanted was approximately 50mm in height. Once again I had my local structural shop cut a ring out of 50mm plate with an OD of 390mm and an ID of 260mm. A second ring was also cut with plans to use it for the male location register on the turret rather than machining it in and losing the extra height. Prior to machining I needed to know the dimensions I was machining

to. The milling head was lifted from the turret with a chain block fitted at the back end and a purpose made frame to secure the front end of the head to the table. Both ends were lifted at the same time (**photos 37 & 38**) to split the halves so accurate measurements could be taken for machining of the risers. The 50mm plate ring was setup in the small chuck and machined to the required size and tolerance followed by drilling (**photos 39, 40 & 41**). A rebate was machined to locate the male registering ring. The registering ring was machine and drilled next. The two components were bolted together and setup for final machining (**photo 42**). Once completed the ring was fitted and the turret assembly remounted (**photo 43**). I now had the extra throat capacity I needed for my vertical slotting attachment (**photo 44**). As a side line interest to the article, I have also designed and manufactured a horizontal slotting attachment for use with the dividing head (**photo 45**). Both the vertical and horizontal slotting attachments have an infinitely variable stroke from 25mm up to 75mm which would cover all my needs. Both these heads give a very smooth slotting action with no vibration giving an excellent surface finish. The second riser allows the head to be raised by 150mm. If extra height was ever required the two risers could be fitted together to give an extra overall height of 200mm.



Method of raising the mill head to measure diameters.



Boring out the 50mm mill riser.



Machining the register of the riser.



Mounting holes for the riser.



Finish machining of the riser.

The barrel of the 150mm riser was rolled from 16mm plate with the end plates laser cut from 12mm plate. After welding the whole arrangement was setup and machined using the headstock extension and the bolt down holes drilled (**photos 46 & 47**). Once again I was surprised by its rigidity and the depth of cut I was able to make whilst roughing down. To be able to machine long lengths in the new setup standard turning tools could not be used as the saddle can't travel under the work due to interference from the saddle extension. To overcome this issue I purchased a left hand heavy duty boring bar which I can use for external turning along a reasonable length (**photo 48**).

Sometimes you look back on a project and think maybe I went a little bit overboard from the original concept. In this case, wanting to be able to swing something at around 380mm and end up at being able to swing up to 680mm.



Fitting the riser.



The mill with additional headroom.



The horizontal slotting attachment.



Machining a 150mm riser.

CONCLUSION

Sometimes you look back on a project and think maybe I went a little bit overboard from the original concept. In this case, wanting to be able to swing something at around 380mm and end up at being able to swing up to 680mm. I now have a machine that is not only capable of doing the general small diameter jobs but can be quickly converted to a machine capable of turning very large diameters with ease. Although the end result was achieved with the milling risers being machined in my own workshop I also learned a lot along the way and came out with some extra capacity I wasn't planning on. An overhead crane certainly wasn't part of the original plan. I was able to push every machine in my home workshop to its limit and beyond and achieve high end results along with a bit of extra confidence to tackle even the most awkward tasks in the future. That 6 inch scale traction engine I am planning to build in the future can now be machined totally in house. Another outcome I wasn't expecting was making contact with the many professional workshops and technical collage in my area and the interest they took in what I was trying to do. The help I was given in sourcing materials along the way made this project possible. You would be surprised at what develops from introducing yourself and just asking a single question. If you look outside the box, as many of us are forced to do with the limited capacity in our home workshops, you might just be surprised at what you really can achieve.



Drilling mountings holes in the 150mm riser.



Using a left hand boring bar to machine long outside diameters.

In our Next Issue

Coming up in issue 232

On Sale 14th August 2015

Jason Ballamy takes a closer look at the EMG-12 endmill resharpener module's performance



Dead Blow Hammers – Ted Jolliffe makes a tool fit for Thor!



Stan Nesbitt describes a home-buildpower hacksaw



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Stub Mandrel's Short End The Potts Spindle



Stub Mandrel looks at a classic bit of workshop equipment.

Model engineering can be a very strange hobby. On the one hand many people are eager to embrace the new with CNC and 3D printers, while many others still champion the Myford 7-series lathes as the ideal machine for the home workshop - a sixty year-old design! In truth, many workshops are a mixture of the old and the new. Many of the hand tools we use today are little changed, if at all, from those that would have been found in a workshop at the end of the 19th century. I have callipers, files and other gadgets that would not look out of place in a Victorian shop.

On the other hand, some tools come in and out of fashion. One such is the Potts Spindle, a simple but flexible device for adding milling capabilities to many machines. As the photo shows, it is a plain bearing spindle designed to be worked by a long belt, usually guided by an overhead pulley. My example was made from castings, has an MT1 bore and is designed



Stub's Potts spindle is the basic design, made from castings.



Many of the hand tools we use today are little changed, if at all, from those that would have been found in a workshop at the end of the 19th century.

to fit in place of a lathe toolpost. A much more sophisticated version has a large boss that fits onto a sleeve which, in turn, is moveable up and down a tall column that fits onto the lathe cross-slide.

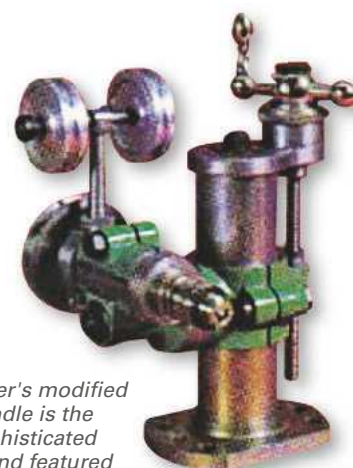
As well as being a home-build project, in the 1940s and 50s the G.P. Potts company made several versions of the spindle, including the column type which had an accurately indexed leadscrew for height adjustment.

So why is this a 'classic'? Well in the fifties and sixties very few hobbyists were fortunate enough to have a milling

machine, many had a vertical slide to allow milling on their lathe, but the 'ideal' solution for many was 'the Potts'.

Sadly, now nearly every workshop has a mill, even the castings for the 'Potts' seem to be no longer available, although Hemingway sell a kit for an Edgar T. Westbury design that is, in all honesty, rather more useful, combining a spindle and a vertical work table.

As for my Potts - I enjoyed making it, but I bought an mill soon after and have never used it in anger. ■



Alan Slater's modified Potts spindle is the more sophisticated version and featured in MEW issue 73.

A Morse Taper Removal Clamp



Paul Lousick offers a sophisticated alternative to pounding the head of your mill with a mallet.

The normal practice to remove cutters which have Morse tapers from the spindle of a milling machine is to undo the drawbar by 2 or 3 turns and hit the end of the drawbar with a mallet. A gentle tap is all that is normally required, but sometimes the cutter is firmly wedged into the spindle after making heavy cuts and requires a much larger whack. This practice makes me cringe every time I do it and cannot be any good for the drawbar thread or the spindle bearings. There are designs for attachments which mount on top of the mill spindle that push the drawbar to release the cutters from the spindle but these are not suitable for my SX3 mill. The spindle on my mill retracts completely into the drive head and I would not like to reduce the amount of contact with the driving spline.

This removal device incorporates two opposing wedges, mounted between the cutter head and the bottom of the mill spindle and does not require any modification to the milling machine. The cutter is ejected from the spindle by clamping the two wedges together. My prototype design used two wedges and a standard G-clamp. This arrangement did work but I found it difficult to centre the clamps on the ends of the wedges and they would easily slip off.



The finished tool.

The final design for the removal tool has a special clamp which locate on the ends of the wedges, making it much easier to operate. The removal clamp was originally modelled in 3D CAD, using Solidworks software before machining the components, making it much easier to modify and fix any problems. The tool is

easily fitted to the bottom of the milling machine spindle and requires very little effort to remove cutters.

Clamp Screw and Nut

The clamping screw and threaded bush is salvaged from a small G-clamp by cutting off the threaded end of the clamp. This is then machined to the final size by holding it by the clamp screw in the lathe chuck. This ensured that the screw thread in the nut is concentric to the outside of the threaded bush. The bush can either be fitted to the clamp with a press fit or secured by Loctite.

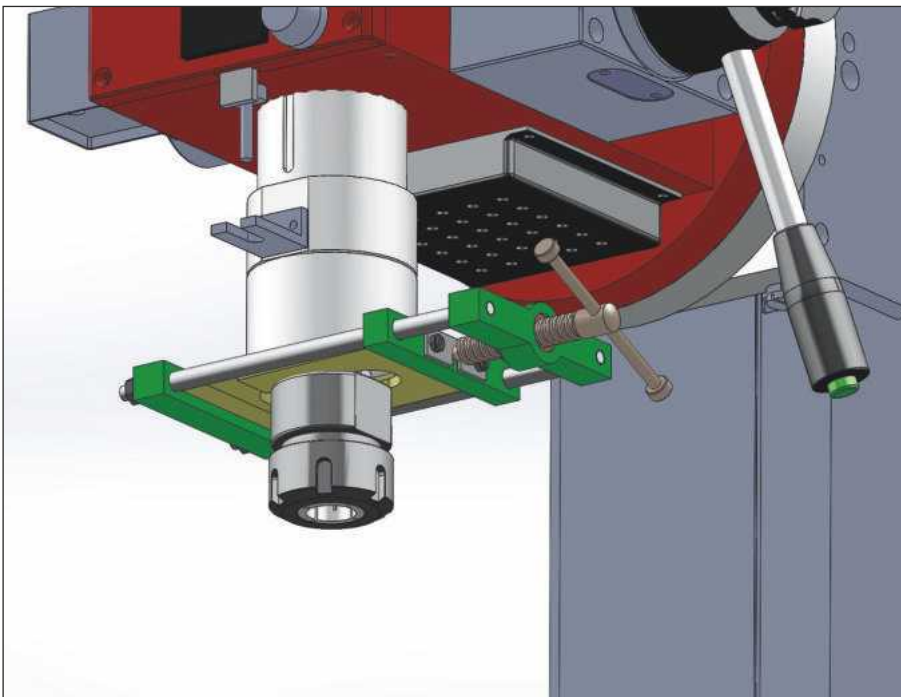
Note that the size of the threaded bush, clamping screw and mating component should be adjusted to suit the G-clamp which you have available.

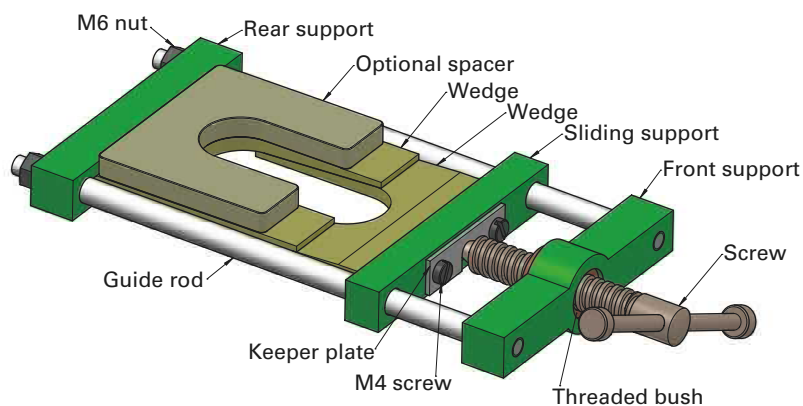
Wedge Plates

The wedge plates were made from 65x5 mm mild steel flat bar, milled to size and finished on a finisher. I chose mild steel, mainly because I already had it in my workshop, and secondly because I prefer to use a soft steel against the mill spindle.

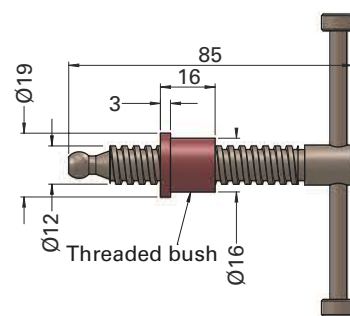
Spacer Plate

An optional spacer plate is used to adapt the removal clamp to milling cutters where the gap between the tool and the spindle is larger than can be accommodated by the clamp alone. Alternatively, the wedge plates could be made thicker.



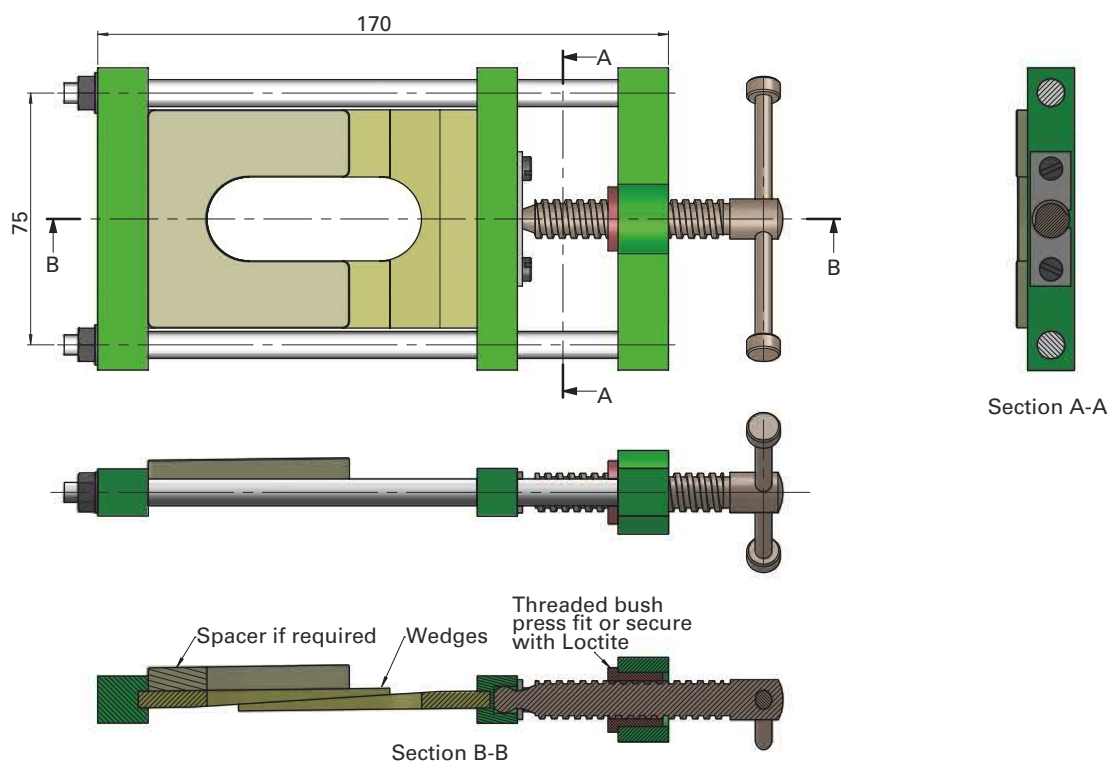


Removal Clamp Assembly



Screw Assembly

General Arrangement

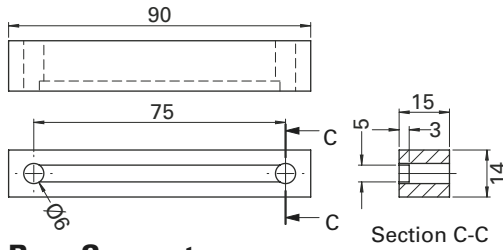


General Arrangement

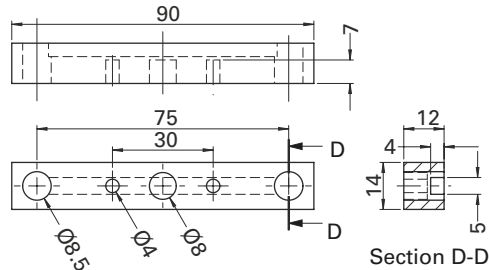
Note: The removal clamp is designed to remove cutting tools from a milling machine which has a No 3 Morse taper spindle. It should also work on a lathe spindle and could be modified to suit other machines which have different sizes of Morse tapers. ■

The removal tool fitted to the mill.

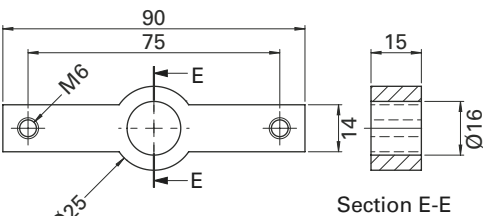




Rear Support

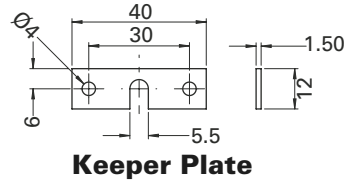


Sliding Support

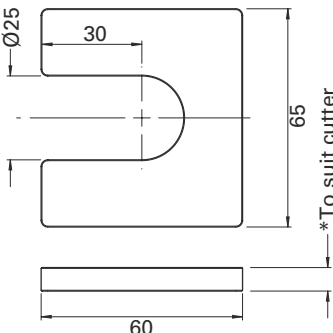


Front Support

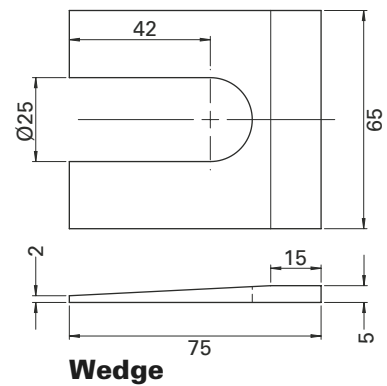
Clamp Parts



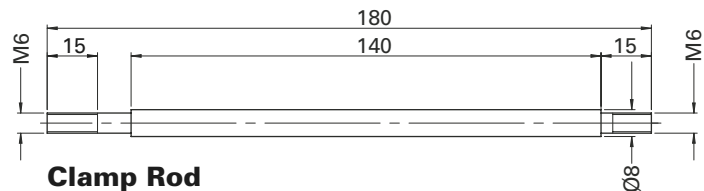
Keeper Plate



Optional Spacer



Wedge



Clamp Rod

MODEL ENGINEER

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- Drill Sharpening
- Mastiff Plus
- Reminiscences of Poole Park Railway



Packing Blocks



Paul Tiney offers a quick and simple alternative to buying a set of packing blocks.

I have, for many years now, got fed up with holding up the job in hand to look for packing pieces in the 'come in handy' box when clamping work. I therefore finally decided to do something about it. Staggered at the price that those old *Picador* blocks are making on eBay, the ones that look like little flights of stairs, I decided to make my own.

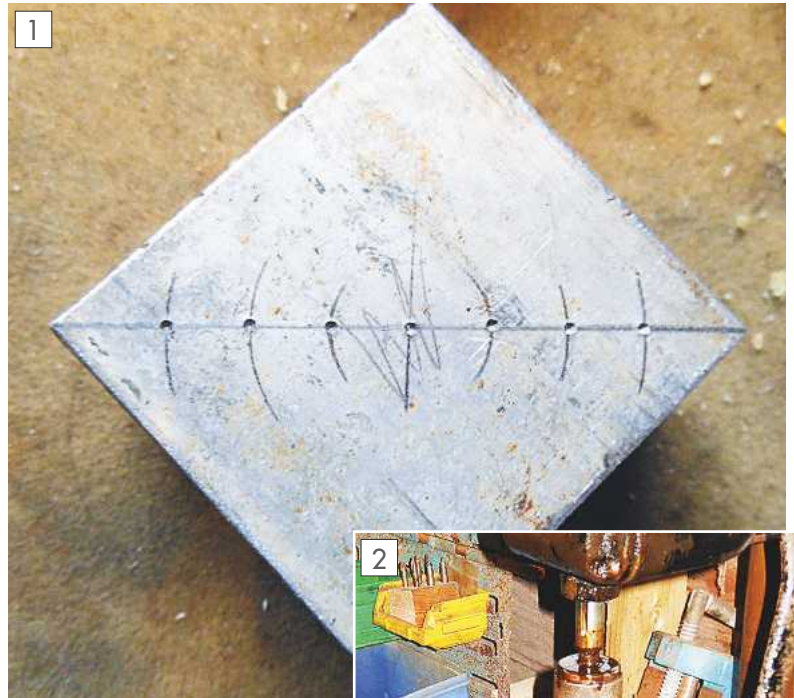
The making of the blocks is simple enough – If you have milling facilities and if you have the patience for setting it up and then making all those necessary passing cuts. By contrast my design is crude but both quick and simple. It also works.

The block marked out for drilling.

- 1) Take a block of metal, material of your choice but aluminium alloy is easy to work. Size, again of your choice and availability. Mine was approximately $1\frac{3}{4} \times 1\frac{3}{4} \times 1$ inch.
- 2) Mark a diagonal line from corner to corner (is there any other sort of diagonal?)
- 3) Mark off on line as shown and centre pop (**photo 1**). Mine was at $\frac{5}{16}$ inch spacing. My method was to start at the centre, where the diagonals cross, and just keep opening the compasses to draw arcs.

- 4) Drill holes (**photo 2**). I used a $\frac{1}{4}$ inch drill and a hand powered drill machine.
- 5) Take up your hacksaw, fit a nice new blade, and demonstrate the skill acquired as a wide eyed apprentice by cutting along the diagonal line.
- 6) Quick rub with a file to remove the sharp edges and you have a pair of stepped packing blocks (**photo 3**).
- 7) Now return to the real job in hand and the interesting work (**photo 4**).

In use the clamping strap benefits from having its back edge rounded off slightly to allow it to settle deeper into the 'step'. ■



Drilling the row of holes.



The finished blocks.



How the blocks are used.



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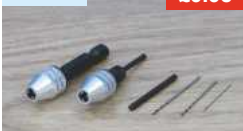
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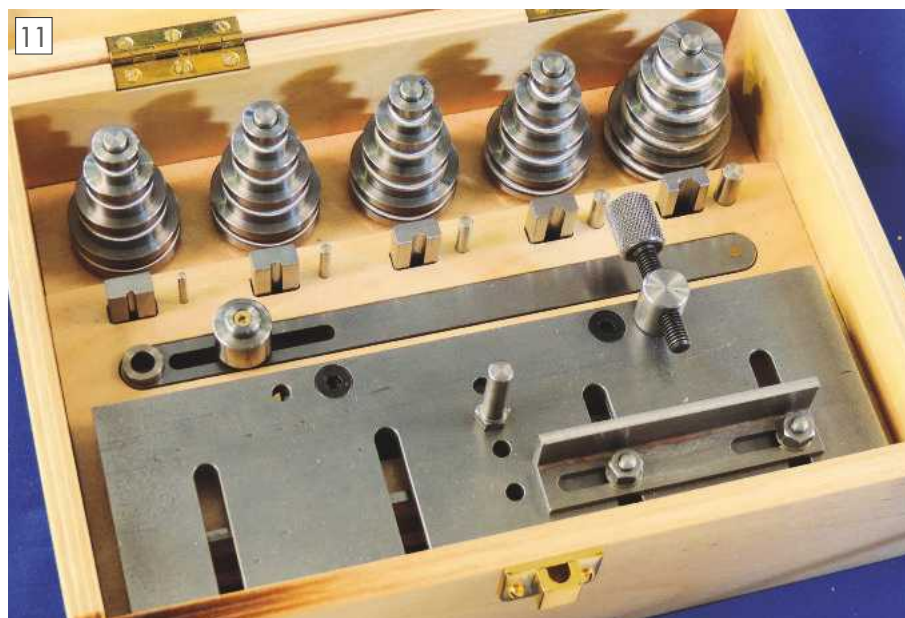
Harrogate Show 2015 Part 2



Editor, Neil Wyatt enjoyed a visit to the National Model Engineering Show in May.

As ever the SMEE stand was a treasure-house of interesting devices, from the tiny Piccolo CNC-bot to the late Peter Spenlove-Spenlove's flight of brass and aluminium spitfires and former *Model Engineer* editor Mike Chrisp's neatly presented set of pipe-bending jigs (**photo 11**). Do you fancy writing these up Mike? Amongst various treasures recently unearthed at Marshall House, the home of the SMEE, was yet another grinder, apparently to an American design, this was a dedicated four-facet drill grinder with a hefty self-centring drill holder (**photo 12**).

That's probably enough grinders after last month's overdose! Other tooling on display included the new Warco WM-14 mill, a very capable looking benchtop machine with built in high-quality DROs (**photo 13**). The machine was attracting a lot of interest, with one machine sold while I chatted to Roger Warren of Warco. For those looking to retro-fit DROs to



Mike Chrisp's lovely pipe bender.



Can you tell us more about this drill grinder?

their machines, a new system has been launched by Machine-DRO with an advanced windows-based interface which was also getting plenty of interest (**photo 14**). A development of their earlier system, this has new software that aids manual setting out of things like holes on a PCD and much more that can run on a standard computer or a tablet that can double as a touch-display (**photo 15**). Good news is that the software (which can be downloaded as a free demo) will come with free updates, one of which is

planned to be 'manual CNC' which may sound odd, but imagine how easy drilling locomotive frames would become if a computer screen was guiding you to the exact location of each hole in turn!



The touch-screen interface is clear and uncluttered.



The new WM-14 on Warco's stand.

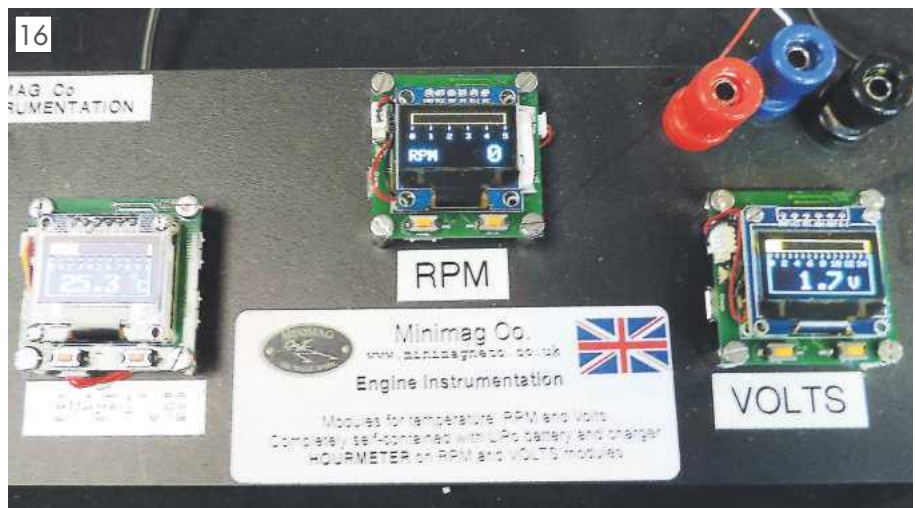


Demonstrating Machine-DRO's new system.

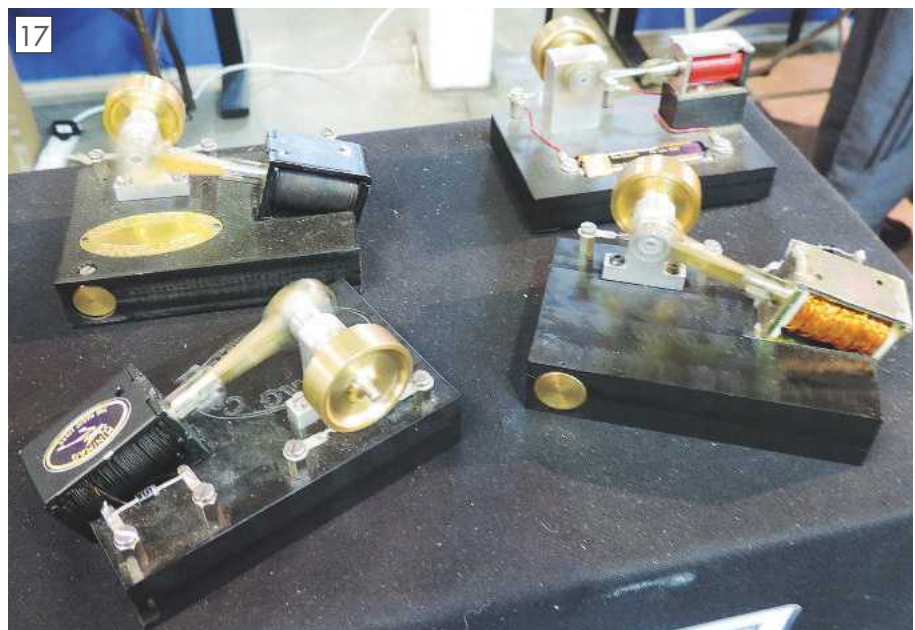
There were more pretty lights on the Minimag stand, in the form of neat modular readouts (**photo 16**). I enjoyed their display which included some fun gadgets and neat little solenoid motors – as well as an Oxo tin of free sweets to help maintain editorial sugar-levels (**photo 17**). A few things I did bring home from the show included a tiny MT0 finishing reamer from TracyTools (for my *Super Adept* project) and a rather long 'Swedish Metre' of aluminium welding wire from Alutight. The enthusiastic sales patter initially reminded me of some of the flaky demonstrations you used to see at car boot sales – I know a lot of people have struggled with cheap aluminium weld. After actually trying the wire on the stand and making a weld I couldn't break I was convinced. One surprising demo was to create a weld pool, pierce the metal and then patch over it using surface tension (**photos 18-21**). I tried out the wire in my workshop, welding a brace onto a telescope tripod with complete success.

Imagine how easy drilling locomotive frames would become if a computer screen was guiding you to the exact location of each hole in turn!

Other stands were selling the usual array of useful items, if only I had a small truck and bottomless pockets! Greenwood tools had some very nice looking spiral-flute taps (**photo 22**), as well as genuine Dormer drills. I didn't pick up any second hand bargains this time, but there were some fascinating



Neat modules from Minimag.



Various stages in the development of Minimag's solenoid motor kit.



Make a weld pool.



Poke it through.



Pull re-melted weld metal across.



And a repair – courtesy Alutight!



Some very nice spiral taps.



Aladdin's cave! Can you identify this small lathe?



Perhaps FIFA should try boat-football instead?



Tooling by D. Watts on the Bradford MES stand.



Three very lovely lions to stand for all the great models at the show.

items on sale, including this small lathe (**photo 23**), can any readers identify it? Finally, there were, of course, an awful lot of models on display, mostly aircraft, boats or engineering subjects. The

battling football boats were great fun (**photo 24**). The Bradford Model Engineering Society had some nice tooling on display again (**photo 25**) and the Old Locomotive Society displayed a

fine pride of Lions (**photo 26**). All in all, I'm sure an awful lot of people found the show a great day out. ■

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Assorted Adepts

Howard Lewis is a fan of these little old lathes, and when he visited the Spalding Show he found three interesting examples.



At the Spalding Model Engineering Show, in April, there were three Super Adepts to be seen, but all differed in some respect.

On the Stand of the Wolverhampton and District Society of Model Engineers, there was a Super Adept which looked to be original, although, somewhat unusually it was painted battleship grey. Like the other, treadle operated lathe on the stand, it was obviously a working machine, judged by the quantity of swarf visible on it. It was mounted on a wooden box which contained the motor, with the belt passing through a slot in the baseboard for the Lathe (**photo 1**).

The stand next door was that of the Stamford Model Engineering Society, which displayed a quite sophisticated version of the Super Adept, together with extra tooling.

This was painted in a shade of blue, which the owner had made as close as possible to the original colour for a Super Adept.

The lathe had come to Sid Clifton from Paul Pennycook, (who owns several Super Adepts), but it had then been subjected to a thorough refurbishment and several modifications had been incorporated.



The first operation after strip down and cleaning had been to locate the bed on its shears to mill the underside of the bed to produce a level face from the original 'as cast' condition.

Whilst on the Milling Machine, the underside of the shears under the Tailstock end was lightly milled to clean up. This was to allow a pad to be added to give support to the cantilevered bed.

This is visible in **photo 2**, as is the resettable graduated dial for the handwheel on the Leadscrew.

Machining of the bed and headstock was not yet finished, for the bed was set up on a Myford Super 7 and the headstock bored out to accept a larger diameter mandrel. The new mandrel was machined to accept 0 MT centres, instead of the smaller ones normally used on Adepts. The larger mandrel also incorporated a larger diameter thread. This necessitated modifying the independent 4 jaw Adept chuck to suit.

Later, a 3 jaw self centering scroll chuck was obtained, and this also required boring out and screw cutting to match the new mandrel.

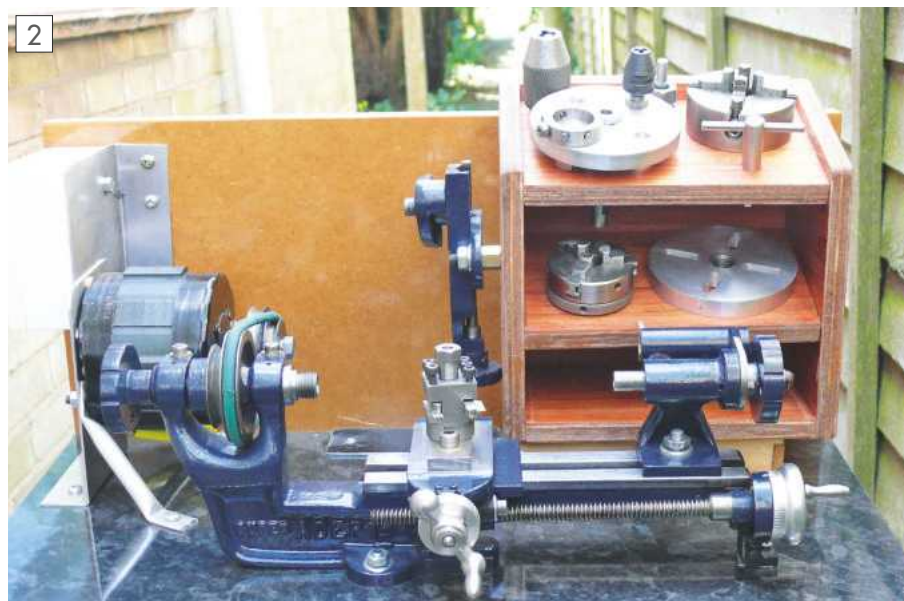
To complete the work on the headstock end of the lathe, a faceplate was made out of aluminium, with a steel centre piece.

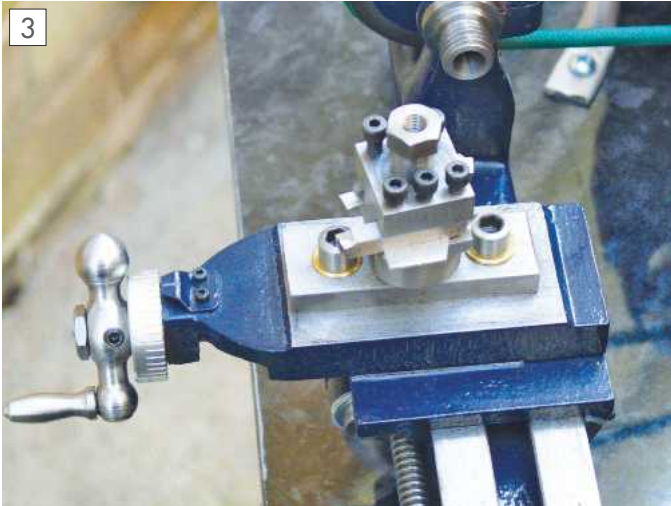
An adaptor was made to allow the original Adept faceplate to be fitted and used, if necessary.

The original cross slide was removed, but can be refitted if taper turning is contemplated. It can be seen, in photo 2, stored on the side of the tool shelves behind the lathe.

The Topslide is mounted on the Saddle, and carries a neat little Four Way Toolpost. Note the graduated dial and index plate in **photo 3**.

Attention now was focused on the tailstock, the mandrel of which was also modified to accept 0 MT centres.





The tailstock body was also modified with a bracket at the handwheel end, and a longer locking screw, to allow fitment of a tailstock turret.

Having been fixed to the tailstock, the carrier was bored to be parallel to the tailstock bore.

The turret is a circular plate, which can be seen in photo 2, carried on a spindle which fits into the additional bore alongside the tailstock body. The turret is located by advancing the tailstock mandrel into a socket on the back of the turret.

The turret carries: a small drill chuck; a holder for $\frac{13}{16}$ inch dies; and has two spare locations for additional sockets, if required (**photo 4**). Again, this shows the index mark for the graduated handwheel.

On the Peterborough Society of Model Engineers stand was another modified Super Adept.

This one had been bought at a car boot sale, on a baseboard with motor, complete with 4 jaw Adept chuck, faceplate, centres, and angle plate.

After cleaning up, by masking the machined surfaces and bead blasting, it was painted in what was believed to be a reasonably close match to the original colour. Like the one on the Stamford stand, the 'as cast' base had also been cleaned up by milling to provide a flat surface. The motor, baseboard and accessories (in a box) were then put in a safe place, and the project shelved for several years.

With the Spalding Show looming the baseboard, complete with motor and accessories was found, (after much searching for the 'safe place'!) and work started on making new multi-groove pulleys intended for 3mm plastic belting. After two failures a new pulley was made for the lathe mandrel, and then another for the motor.

In fact, a standard 4mm section BS 'O' ring was found to be a suitable drive belt. It provides the advantage of a safeguard against overload, by slipping!

Attention was then turned to the Motor and wiring. The clamp intended to secure the motor resilient mounting to the base was missing at the non drive end. Making a replacement turned out to be an expensive operation as a 4mm end mill was broken, by hamfisted milling of the slot in the two parts of the clamp. With the motor secured, the tape covering the wiring, and what was assumed to be a capacitor was removed.

This revealed the wiring to be joined by merely twisting together bare wires, and the 'capacitor' actually to be a relay in a Bakelite box with one side broken away, to reveal the internals.

The wiring was fixed by soldering the connections together and covering the joints, and the wiring in general, with heat shrink sleeving. The connections to the relay were remade using crimp on ring terminals. The broken relay box presented more of a problem, until it was found that a plastic box, which had once housed a 2MT stub arbor, would fit nicely over the wires and the box, so as to prevent contact with any live wiring or terminals. The plastic box was drilled to allow it be clamped using the same 6BA bolt that secured the relay to a bracket attached to the motor frame, and cut to length before fitting. The mains supply cable was clamped, to provide a strain relief, and an on/off switch fitted.

The original splash back had been just a curved piece of Aluminium sheet, screwed to the baseboard. This was rejected in favour of making a safe edged sheet steel chip tray and splashback, which was painted grey (because that was the aerosol paint most readily to hand!)



The original, roughly (in all senses of the word) 12 inch square baseboard was replaced by a neater, dark grey faced chipboard one, 12 by 18 inches, as seen in **photo 5**.

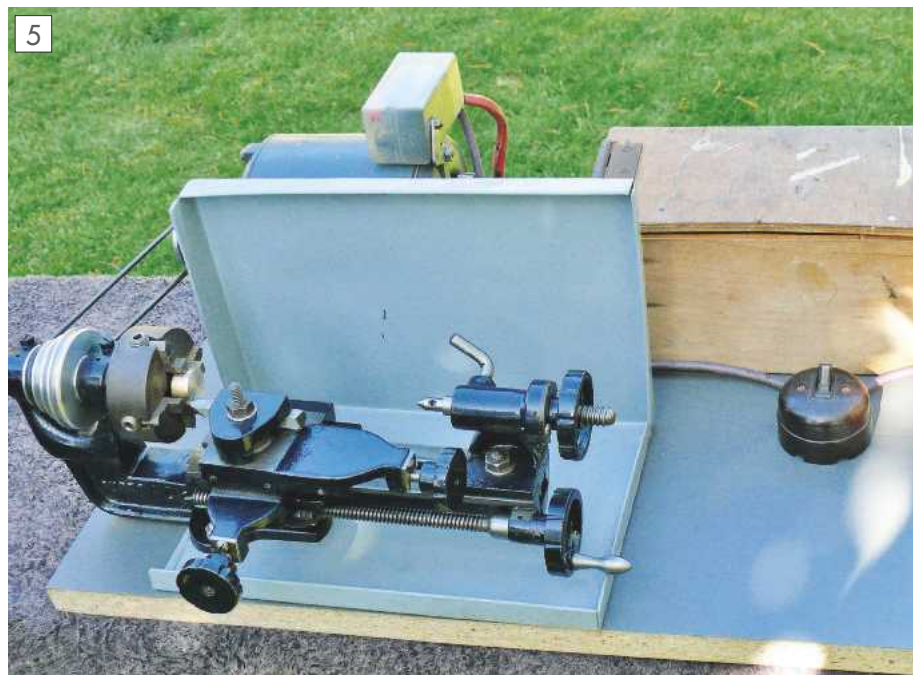
Since time pressed, its ability to cut was very briefly assessed using a tangential tool (as per Autumn *MEW* 2009) although this is a little too large for the Adept, and then one of the toolbits that came with the lathe.

With a bit of tool grinding, it should soon be possible to use the Super Adept for light work, as and when required. Next job will be to make a tool centre height gauge to make setting up easier.

As an interim measure, the original tatty plywood box for the accessories has been retained. That is another 'round tuit' job for the future.

For anyone interested in the history of the Adept and Super Adept, *Introduction to the Adept Lathe* by Andrew Webster is informative and interesting reading. ■

Editor's Note: The original version of Andrew Webster's monograph can be found at www.lathes.co.uk/adept.htm



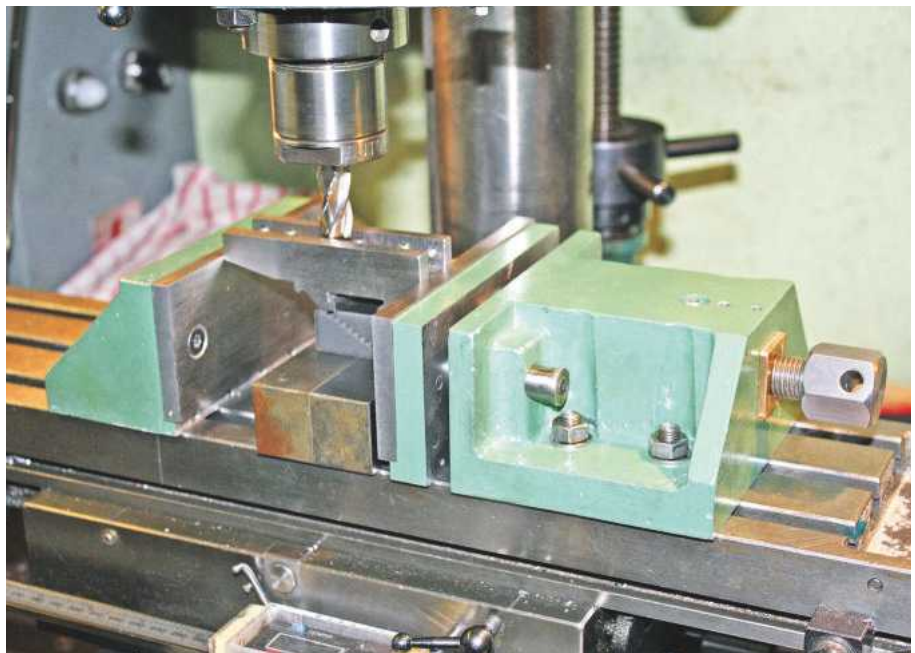
A Table Length Milling Vice

Part 2



In this series, with beginners in mind, David Piddington gives a step-by-step guide to machining a milling table vice of his own design. The castings and full size drawings for the vice are available from Hemingway.

The original concept of this vice was taken directly from similar commercially available ones which are too large for model engineers like myself who only have workshop space available for lathes such as the Myford Series 7 and smaller mills such as the Senior 'E', for which the two prototype vices were made. My own workshop measures 11½ by 7½-feet so storage and workspace comes at a premium.



Photograph 21: Using some marking colour on the top surface of the sliding jaw, scribe a centre line as shown but try to do it better than in this photo. The actual centre is the brighter of the two lines on the end nearest.

Photograph 22: Align the 'cone' end of the clamping block to the edge of the mill table and with a pointer from the quill above wind the table 'y' axis to and fro until the scribed centre coincides with the pointer for the full travel.

Photograph 23 is a close-up of pointer alignment at nearside. Now carefully clamp the casting securely with the toes of the clamps the minimum safe distance

inwards from the edge. Do not forget to set your scale/s to zero - NOW!

Next move the 'x' axis sideways each way by exactly 1½ inches (or to whatever your table T-slot centres are dimensioned) and set a carriage stop at each.

Photograph 24: Now from the top front edge of the 'cone' face scribe two more lines across the original centre line, the first 1 inch in and the second 2½ inches in. Photo 24 shows the pointer alignment. Note your dial or scale reading and/or set stops if you have these.

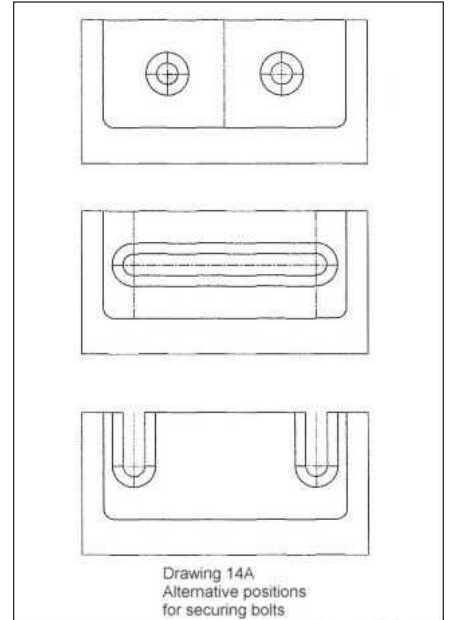
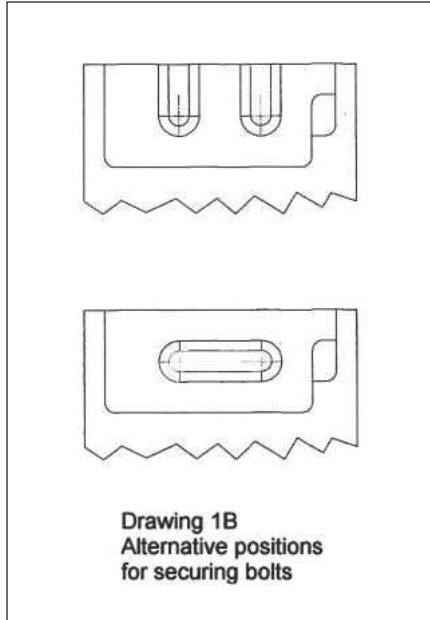
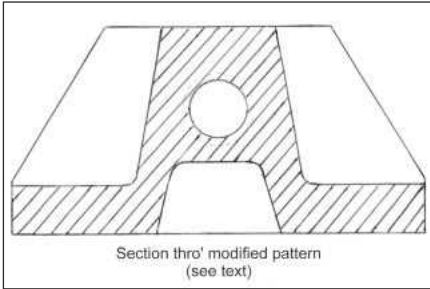
We now have a 'box' of four positions, to which the attachment bolt-holes may be drilled. Again do not drill right through at

this stage: do that later when you have removed the casting from the mill. You will also need that extended centre drill again.

For machines other than the Senior 'E' you must check dimensions before drilling any holes in these castings. The designer regrets he does not have access to other machines to check possibilities though **figures 1B** and **14A** give some ideas. **Photograph 25** shows the drilling operation at the first of the four holes.

Photograph 26: Having completed the initial hole-drilling I noticed a snag. Due to a mistake while making the pattern – this was modified for production – I made it a bit too wide and it will be seen that a





considerable spot face was required for the securing nut and washer to be used when finished. As I use Myford tee bolts and nuts on my mill, though dedicate ones to fit would be better, I continued with this theme. The Myford washer is $\frac{3}{4}$ inch diameter and by good fortune I had a new $\frac{1}{16}$ inch plain shank slot drill – I've had it for years – and as can be seen was effective in solving this problem. It may be that for your machine this problem may still be there, so here is the solution. It is ideal to spot face these holes and the same method may be used.

Photograph 27 shows the opposing side, which required a small amount greater of metal removal cut into the sliding jaw side – another slight difference in the pattern made by an amateur – me! Ultimately I made some special tee-nuts and studs $\frac{5}{16}$ inch BSF that have proved adequate.

Before removing the casting for the next sequence it is recommended to machine a 'witness lane' on the top edge of the 'square' end. To do this it is necessary to move the stops set for hole-drilling but without moving the casting at this time.

On my 'Senior' mill it is possible to leave the stop set and lower the stop block.

Photograph 28: This photo shows the 'x' axis stop engaged and 28A with the stop block lowered. With this arrangement and keeping the stop itself in the same place, the table can be returned to the original Zero point if you are making two units. The same procedure as above will be followed to set the casting's position on the mill table.

The witness is shown in **photo 29**; a $\frac{1}{4}$ inch depth is sufficient and is shown to have just cleaned up across the face width.

Photograph 30: Next we have to clean up the whole of the rectangular face of the block. Your 'sacrifice' angleplate will be used and attachment holes require to be drilled into it. My own angleplate is shown here from the back of the assembly showing the casting G-clamped to it. The plate itself I had previously drilled two attachment bolt-holes – these are just visible, and had set it parallel to the 'x' axis prior to this assembly being created.

Photograph 31: is the front view of this assembly taken earlier with just the one





clamp. The witness lane machined earlier is now seen and being levelled to the underside of a height gauge's pointer.

Photograph 32: This is the other view proving the setting, after which the second clamp was put on in similar fashion to the photos 13 and 14.

Photograph 33: It is now possible to spot through the sliding jaw's attachment holes into the angleplate and attach it as shown. I used all four holes for added security, but only had three suitable bolts and so substituted a Myford Tee-bolt for one. During machining I realised that additional support was required due to the cutting action flexing the angleplate mount with only two fixing bolts. A couple of short steel offcuts were lightly wedged under the cone-end flanges and additional clamps vertically on top of these arranged as shown in this photo. The cure the problem.

Photograph 34: The 'witness lane' about to disappear after the final facing cut across. This particular operation is solely to remove the tapered draft angle side of the casting though the sliding jaw will come close to it in the withdrawn position. It will be good to skim off the opposite end face as shown in **photo 34A**, and much easier to clamp down. Face off the minimum of metal to just clean up the surface and remove burrs as required.

Photograph 35: The sliding jaw carrier now needs four holes drilled in it to take attachment bolts to secure it to the clamping block prior to the boring process for the feed-screw and other associated parts. This photo shows the initial centre drilling. 'x' and 'y' axes were set to limit stops. Also, unseen in this view is a limit bar fixed into



the rear table tee-slot for location.

Drill these holes – best to use the bench drill - actual size for the bolts you will use. Use a letter 'D' drill if you have one. They do not require super-precision, but they are almost as good as a dowel for the 1/4" BSF socket cap screws which I had to hand, as they are only temporary to hold the sliding jaw carrier on to the clamping block to enable in-line boring for the clamp screw. These were longer than required, and the excess from two of them were used later to plug the holes in the main block upper flanges. (Such threaded offcuts are often long enough for conversion to slotted grub screws, which for purely cosmetic reasons will be used later.)

Always make sure you have the correct taps before drilling bolt-holes.

Photograph 36A to C: Next fasten the sliding jaw back on to an angleplate on its 'cone' end as shown in this photo with a bolt through. Centralise the sliding jaw carrier by 'finger feel' against the bottom edge of the block.

A: Now firmly clamp the sliding jaw carrier to the sliding jaw ensuring that the bottom edge of the former is in firm



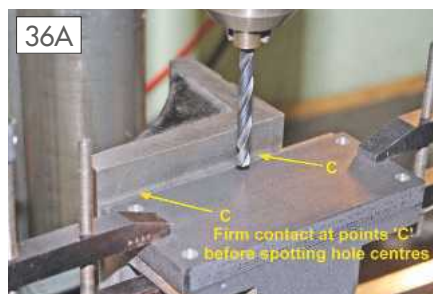
contact with the angleplate, Centralise it by 'finger feel' against the bottom edge of the fixed block before clamping and spot through the holes with the same drill. Do not go deeper than the drill point plus 1/32 inches.

B: An additional 'G-clamp' will ensure the contact between the angleplate and the bottom of the sliding jaw carrier.

C: On my prototype it seemed that the lower holes would break through the bottom internal radius of the casting, so set a depth stop to your drill as shown in this photo so that it does not. The upper holes can pass through the casting and all four should be plugged later prior to painting.

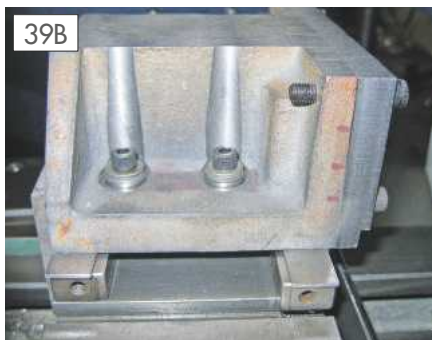
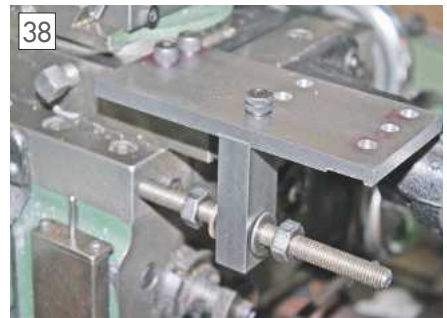
Do not remove the clamps before you have tapped all the holes and tightly fitted the cap screws. Tip – swarf may be removed from the bottom of blind holes with the tang end of an old magnetised round file. Air jets are very effective but best to avoid as swarf can be blown into eyes (and far corners of workshops).

Photograph 37: Using the flycutter now take a minimal cut across the top of the combined sliding jaw and sliding jaw carrier to just clean up right across to



C Firm contact at points 'C' before spotting hole centres





enable support of work pieces that overhang both front and rear jaws. Set a depth of cut stop, as the fixed jaw top needs to be milled to the same setting. See **photo 37A**.

We now approach the boring process for the sliding jaw and carrier. The locking screw axis is recommended to be slightly **above** the jaw centre line so that clamping forces on workpiece will tend to push the latter downwards into the vice unlike most commercial vices that have the screw centre on, or even below the desired position. These will eventually wear and the jaw tendency is to let the workpiece slip undesirably upwards. I have seen, and done it myself in ignorance before seeing 'the light', vices ruined by careless use, mostly that of hammering the handle in an effort to secure the workpiece even tighter.

There is one feature of the Super 7 lathe, a lack of facility in my opinion, in that there is no convenient means of locking the cross slide. This can be 'forced' though not recommended by the simple tightening of a centrally disposed side adjustment screw but mark it so you can replace its adjustment later.

Photograph 38 and 38A: I had originally intended to do this by direct reading off the cross slide dial working from the centre outwards and had made two special front and rear stops for this purpose. It then occurred to me that with the backlash in the screw and nut, it would be impossible to get the accuracy required with just the stops on their own but having achieved a better setting the stops could be successfully used. The additional holes

in the top were due to an error and additional slots underneath would, it was hoped, add versatility to these units.

Photograph 39: The sliding jaw and carrier assembly may now be trial-fitted to the cross slide. The Super 7's has that large hole at the front from which the top slide assembly has been removed. Power cross feed S7 owners must plug this hole (Myford sell a plastic moulding one with a 6-mm threaded extractor hole) to avoid swarf ingress to the internal gearing. I would recommend all S7 users to do the same.

Packing blocks will be required between the cross slide and the clamp block. The vice jaws will be 2.¼ inches wide and measuring up from the top of the jaw step (Images 20 and 20A) their centre line will be 1.⅙ inches. ⅙ inch thick packing bars will thus be required for the screw axis to be ⅙' **above** this dimension and their ends can be seen in **photo 39B**.

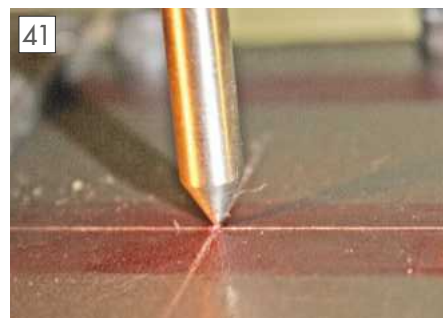
This 'posed' photo also shows one of the embryo vice jaws – a large-ish flat plate - pressed carefully against both the side of the cross slide and the 'cone' end of the clamping block. For our purposes this should be accurate enough. Ensure that no movement takes place while tightening the clamp nuts.

Photograph 39A: This photo shows the front clamp arrangement. The standard Myford clamp dogs are not long enough for this job but I had made many years ago a slightly larger pair of stepped dogs and these proved ideal as can be seen. It is often worthwhile holding progress on a project to make special items like this and then keep safely for the future.

Photograph 39B: This photo shows the rear view of the clamping arrangement using socket cap screws.

There are three holes required in the sliding jaw and carrier assembly already mentioned. Take a piece of ¼ inch square bar steel bar, or a section which includes this dimension, about 2.5½ inches long and on the ¾ inch face centrally dispose two ½ inch reamed holes at 1.5625 inch centres (**photo 40**).

Photograph 41: Now go to the sliding jaw and carrier assembly and carefully scribe a vertical centre line on it. This could be more conveniently done prior to assembly on the lathe. Some marking colour will help. Next scribe a horizontal centre line on the lathe axis height and at





It is vital to set a depth stop or there will be loud graunching noises as the tool tip attempts to face the cavity's bottom.

the intersection and using a lens, put an accurate steel pointer in the chuck and position the point and intersection as shown in this photo. Do make sure your clamps are secure.

Observant readers will note that images from this point on will show the jaw ledge bars are now secured as described under section 20.

Photograph 42: Now commence machining with a centre drill and then opening up a hole right through the clamp block assembly up to $\frac{3}{16}$ inch diameter and then ream through $\frac{1}{2}$ inch diameter.

Photograph 43: Obtain a length of $\frac{1}{2}$ inch diameter ground silver steel (I believe our USA cousins call this 'drill rod'), whichever: what is required is precision ground bar stock; two pieces, one of around 4 inches long and the other long enough to pass right through the now reamed hole. This photo shows the procedure where the setting block is placed first over that end protruding from the sliding jaw and carrier assembly and the other protruding about $2\frac{1}{2}$ inches from the chuck. NOTE that your chuck MUST be running truly to the test bar. If not I advise using a collet instead. Adjust the cross slide carefully until the setting block will slide freely along the chuck spigot, tested by sliding the lathe saddle sideways as in this photo.

Photograph 44: Next centre drill and drill Letter 'D' just into the cast iron by no more than $\frac{1}{16}$ inch (**photo 44A**). The 'D' size is the one I use for $\frac{1}{4}$ inch BSF socket cap screws, which are made slightly under nominal diameter on the thread. I've included an photo here though not really necessary.

NOTE – when final assembly is done, open up these two holes with either a $\frac{1}{4}$ inch drill or reamer but do not do it at this time.



Now if you have a $\frac{3}{8}$ inch counterbore, use it to a depth of $\frac{5}{32}$ inches for the head of the cap screw just mentioned. If you haven't, use a $\frac{3}{8}$ inch slot drill, or even a standard drill and then a 'ground off square' standard drill, the first to about $\frac{1}{8}$ inch only.

Repeat but with the cross slide wound across to the other position. Do not move the cross-slide again before completing the next stage.

Now remove the front plate and carefully remove burrs from around the front and rear holes.

Return to the lathe and open out the hole in the casting to a $\frac{1}{2}$ inch reamed hole.

Replace the sliding jaw carrier, realign the setting block and bars to the opposite end hole. Remove the sliding jaw carrier again and repeat for the second $\frac{1}{2}$ inch reamed hole. Ensure when replacing the locking jaw carrier it has the central bar in situ.

For the last time, replace the sliding jaw carrier and realign the cross slide yet again to the central position. Now remove the sliding jaw carrier once more.

Photograph 45: You will now need the $\frac{3}{4}$ inch reamer and preferably a $\frac{43}{64}$ inch drill to precede it. Alternatively you will need a between-centre boring bar long enough for the centre part to traverse the length of the sliding jaw and have that same length at each end. The b/c bar should also be robust, say, $\frac{5}{8}$ inches diameter. You will also need to make up a 'go/no go' plug gauge to test for the finish diameter. Photo 45 shows the extended type 2MT shank reamer I acquired many years ago and one of those bargains too good to be missed.

Photograph 46: Next needed is an adjustable boring head as shown in this photo with the front cavity completed. Use a short-reach carbide tipped boring tool at about 200 rpm, taking about 0.015 inches



per cut. It is vital to set a depth stop or there will be loud graunching noises as the tool tip attempts to face the cavity's bottom. It will be noted that I marked the face – using a jenny calliper – to give a target to aim for when advancing the cut.

I do not remember ever seeing instructions of safety aspects when using these devices but it occurred to me that, as the spindle has to be stopped for each adjustment of cut, it would be prudent that the same hand adding the cut to the boring head is also used for re-starting the spindle. It would be catastrophic if the restart occurred while the operator was still holding the device.

Photograph 47: Here in this photo is the special boring bar for back-boring the reamed hole to accept the jaw screw nut, which will be made to fit this bore. It was at this point of construction that the note about reading ahead was added to the start of the text for the author had to make this bar without access to the lathe. Tricky, but not impossible. For Myford 7 users make the bar itself 9 inches long and, as shown in the photo, its inner end is held against the end of the headstock spindle enabling its removal and replacement after measurement of the bore.

To be continued...

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A bit of history

Back in the 1970s I was looking for a horizontal milling machine to augment my workshop. Not long before, I had acquired an old Myford ML7, used previously mainly in the construction of clocks. Therefore, there was little apparent wear from cast iron dust, steel swarf etc. It was covered in what looked like shellac, so I decided to dismantle, clean, and check it for wear – of which there was very little. It was repainted and reassembled.

The Trident C Milling Machine, which I found for £50 was in a sorry state. Recently I found that mine of information, www.lathes.co.uk Looking under Pallas Millers, Model C Miller, I discovered that the Model C was manufactured from the late 1920s and was originally flat belt driven and with rack and pinion feeds on all three axes. There were screw feeds on the cross and vertical travels. By the time I bought it, the rack and pinions had been removed, and a screw feed had been applied to the knee slide, but annoyingly with a left hand thread. A previous owner had converted it to V belt drive with a motor bracket and lay shaft on hefty angle iron frames on the left hand side of the machine. The photograph, top right, shows it after the initial improvements but before the current refurbishment was started.

The Miller's Tale

In the latest of our sequence of articles on restoring vintage milling machines, the Revd. Ian Strickland recounts the story of the magnificent Trident Mill he brought to the 2014 Model Engineer Exhibition.



Stage 2

Having trued up the vertical surface, the V slides were tackled next. It is easiest to tip the casting over so that one dovetail surface is horizontal (A leg of 1 x 1/2 inch black mild steel was used bolted through one of the holes in the foot of the casting to support it.) To measure the dovetails, a micrometer device was made up with 1 x 3/8 inch BMS bar with a piece of ground stock screwed on one end, and a micrometer head on the other (**photo 16**). Those who have made the Quorn T & C grinder might recognise the micrometer head. This wonderful gadget revealed that the column dovetails were about 0.008 inch wider at the top than the middle but that the middle two thirds was parallel to within about 0.001 inch. For clarity **photo 17** shows it being used on the knee slide, which is upside down in the photo.

Photograph 18 shows the early stage of correcting one of the dovetails with the high (bright) areas clearly visible at the ends. Filing continued till half the error was removed from one of the dovetails, then the other dovetail was worked on similarly to remove the other half of the error. The blued reference surface was now a length of inch square BMS about the same length as the dovetail, with one side scraped true to the glass surface plate. Surprisingly it took only an afternoon to bring the dovetails back to parallelism.

Correcting the mating Vs of the knee and its gib strip should be left until after the knee slide (Y-axis) has been squared up with the vertical face of the column (Z-axis), and the knee slide (Y & X-axes) in the horizontal plane.

Stage 3

Using the front of the column as the blued surface, the vertical knee slide surface was next for attention (**photo 19**). This involved taking about 0.004 inch off one side of the surface to bring the horizontal knee slide (Y-axis) back to squareness in the horizontal plane, with reference to the vertical face of the column. Work was proceeding well, so I thought, until the knee was refitted to the column for Test 5 to be repeated. Horror of horrors, I had taken the metal off the wrong side and had just spent an afternoon making matters worse! The error was now 50% worse than it was before I started. Time for a cup of tea and a chocolate digestive or two!



Trident C horizontal mill.

A Lesson learnt

It is easy when working with an engineer's square and feeler gauges to see which way things are out, but I did not find it intuitive when working with the DTI. So I resorted to a sketch to figure out which way things were out.

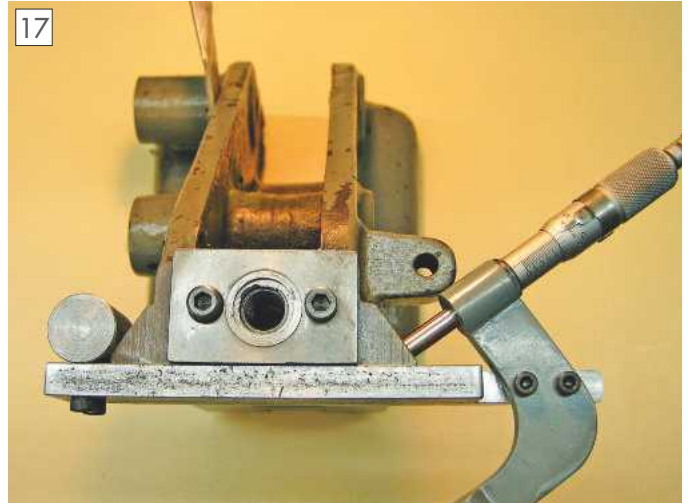
Referring to **photo 20**, the metal had been taken off the right hand side (as viewed from the front of the machine) i.e. the side where the gib strip is fitted, which was much easier to work on than the left, because there is no overhanging dovetail surface to hamper progress. This doubtless subconsciously affected my decision as to which side the metal had to be removed.

The dovetail included angle is 55°, so a triangular file cannot be used to remove metal under the dovetail. Another new half round file had to be purchased, but this needed modifying by grinding off the half round surfaces for about an inch from the tip to about 50° included angle so as not to foul the dovetail (**photo 21**). Working into the corner of the dovetail was difficult because the file left a neat row of parallel grooves in the corner. Time for more thought. The diamond laps could be pressed into service but not until one edge had been ground away to about 50°. It was still quite fiddly holding the thing, but the



16

Dovetail micrometer.



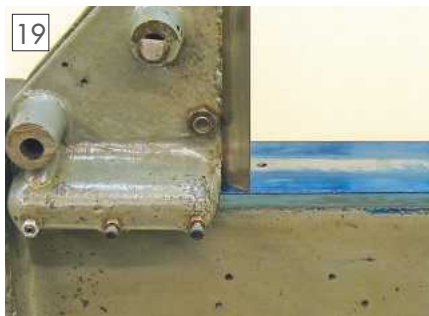
17

Measuring dovetails.



18

Filing in progress showing high ends of the dovetail.



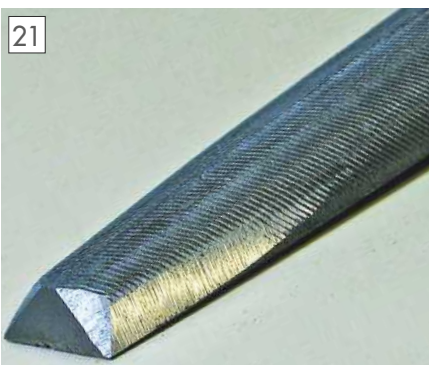
19

Using the column to true up knee slide.



20

Progress with marking blue.



21

Modified half round file.



22

Legs clamped to the knee facilitates working on the slide.



23

Test 4. Checking squareness of the top of the knee (Y axis) with the face of the column.

The top of the knee slides had been trued up back in the 1970s, but even so it was checked against the flat surface and some wear had to be corrected.

cut out in the casting (originally for the rack and pinion feed) was just wide enough to get a finger under the lap to hold it firmly.

The knee is a heavy lump of metal so a couple of legs were bolted to it so that the surface needing attention was horizontal (**photo 22**). The keen eyed may have spotted a nut to the left just below the dovetail. A ½ inch high tensile bolt was installed when I first overhauled the mill because a crack was found in the casting at the bottom of the groove cut out for the original vertical rack and pinion.

Cut and try continued, using the files and the coarse diamond lap until the error in Test 5 was reduced to about 0.002 in 4 inches (photo 12). It was now time to bring the dovetails on top of the knee (Y-axis) back to parallel, as this slide was being used to obtain the readings for the Test 5. Once this was achieved, Test 5 was repeated, and the error now measured was nearer 0.003 in 4 inches. As a check on the squareness of the engineer's square, Test 5 was repeated but with the blade of the square on the RHS of the column rather than the left. The figures agreed to within a thou' in 4 inches.

Now attention was back to the vertical face of the knee for the final push. The target error was 0.0003 in 4 inches, i.e., about 0.001 in 12 inches, which is close to the figure I found in the machine tool book referred to earlier. Test 4 was repeated to check the squareness of the Y-axis in the vertical plane with respect to the vertical face of the column, except that this time the engineer's square was clamped to the vertical face, and the DTI used on the under edge (**photo 23**).

The top of the knee slides had been trued up back in the 1970s, but even so it was

checked against the flat surface and some wear had to be corrected. This was a mere trifle compared to the other surfaces that needed attention.

Stage 4

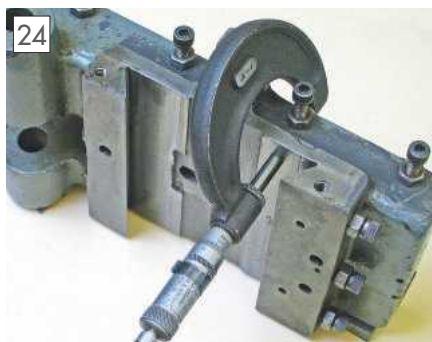
Test 6, parallelism of the horizontal sliding surfaces of the intermediate slide between the knee and the table were checked next, (X and Y-axes) and found to be within about 0.001 inch (**photo 24**). However, correction was necessary as the wear marks on the top slide indicated poor contact with the underside of the table. The top of the intermediate slide was offered up to the flat surface plate and found to be convex, i.e., worn down at the left and right hand ends (**photo 25**). As before, the bulk of the metal was removed by filing.

The dovetails, which support the table, had to be brought back to parallel, before Test 3 could be repeated, to check the error of the X-axis with regard to the vertical face of the column in the horizontal plane.

Test 7, before the sliding surfaces of the knee to the column were improved to about 75% contact, it was necessary to recheck that the X axis was perpendicular to the face of the column in the vertical plane (**photo 26**). It was found to be about 0.0015 inch out in 4 inches. A little 'twist' of the knee in a clockwise direction, as viewed from the front, was needed to correct this error. This entailed taking a little metal off the top of the left (fixed) dovetail. Now, all you time served men avert your gaze. My solution was to stick 500 grade wet and dry abrasive paper to the left column dovetail with double sided adhesive tape and to lap the knee dovetail to the surface of the column which had already been trued up. Needless to say the abrasive paper was used dry. Pressure was applied to the top end of the dovetail to remove more metal where necessary. It took about 300 strokes to achieve this, and about a further 500 to establish about 75% contact. Progress was checked with the aid of a dental mirror to look into the dovetail. Frequent stops were made to brush the wet and dry paper with a clean old toothbrush to remove the accumulated iron dust from the abrasive paper, which quickly clogged the surface.



Test 7.



Checking parallelism between top and bottom of the intermediate slide.



Top of intermediate slide.

Much to my surprise readings at the ends of the table showed they were high by about 0.003 inch, which was much more than the micrometer had showed.

Attention now returned to the knee surface which mates with the front of the vertical column. The same method was used of sticking wet and dry abrasive paper to the column, but 250 grade was used initially as a larger surface had to be lapped.

When jacking the knee up and down it was apparent, that the knee was 'tipping up' about 0.002 inch when screwed up, and 'tipping down' when pulled down by the vertical screw, as the oil meniscus came and went at the point of contact at the top of the knee slide and the vertical column. Investigation revealed that the crack I had found when first overhauling the mill had now progressed down to the bottom of the cut out for the original rack and pinion feed and was allowing the bottom of the knee dovetail to spread apart slightly when loads were applied vertically via the screw. A length of 0.625 inch diameter threaded rod was put through the cast holes for said pinion shaft, nutted at both ends, tightened up, and hey presto problem solved! Photograph 22 showed said holes being used for the temporary support legs.

Tests 3, 4 & 5 were repeated, and some more fettling of the X & Y surfaces and dovetails was needed to bring them close to my target.

Stage 5

Attention now turned to the table. Initial checks of the top surface with the surface plate showed slight undulations which were scraped away as the errors were small. Careful measuring with a micrometer to check for parallelism of the top and bottom surfaces revealed that they were apparently



Underside of table – DTI checks for parallelism.

within about 0.001 inch. As a check, the table was placed upside down on the surface plate and readings taken onto the mating surfaces with the DTI (**photo 27**). Much to my surprise readings at the ends of the table showed they were high by about 0.003 inch, which was much more than the micrometer had showed. The surface plate was turned over and the test repeated, which now showed almost no error.

Another lesson learnt. Check everything, even the surface plate. This was done by using the 1 inch square bar, which had been used for checking the column dovetails, and a 0.0015 inch feeler gauge. Checks were made on both sides of the surface plate, and also at right angles to each other. It was now clear that the glass was flat for all intents and purposes in one direction, but slightly warped in the other by about one to two thou.

Now that this had been established, checks were made of my lump of cast iron used for lapping, and of the top surface of the intermediate slide. Both were found to be flat to probably to less than 0.001 inch as friction in trying to pull the feeler gauge out from under the inch square bar was pretty much equal (**photo 28**).

Having established which way the surface plate was flattest, the DTI test to check parallelism of the top and bottom of the table was repeated, this time with readings agreeing pretty much with the micrometer. The underside of the table was a little high at the ends, as expected, and the high areas scraped away. Getting under the dovetails was much more difficult as they were shallower and some way back from the front and rear faces of the table.



Checking flatness of lapping iron with inch square bar and feeler gauge.



Pattern for mandrel pulley.

Trying to establish the straightness of the dovetails, both to the underside of the table and the top of the intermediate slide, was not easy. It was clear from visual inspection that there was more wear to the table dovetails towards the right hand end. Measurements with 1 inch lengths of ground stock in the Vs and using a digital caliper gauge showed the table dovetails to be about 0.002 inch wider at the right hand end. Checking straightness was not so easy. A length of silver steel rod was checked for straightness, and then put into the dovetail, and lightly clamped at each end. Then checks were made with a 0.0015 inch feeler gauge. This test was inconclusive.

How to true up the table slides? As the dovetails were wider at the left hand end, I resorted to abrasive paper stuck to the intermediate slide gib strip. The table and intermediate slide were now reassembled, and the gib strip adjusted finger tight on the adjusting screws. The table was now moved to and fro until the tight spots had been removed. This was repeated with the table put in the opposite was round to lap the other dovetail. I assumed that both dovetails were the same angle. Seating of the gib strip had to be improved by making the ends of the adjusting screws rather more pointed so as to sit more centrally in the dimples in the gib strip.

Stage 6

Time to turn to some improvements. The first was to change all belts to poly-V belts as these are much thinner than conventional single V belts and so better able to fit small pulleys without being excessively flexed. The motor pulley was nominally 2 inches in diameter, and the main belt was very much the worse for wear from being bent around this small diameter. Secondly, the small pulley on the mandrel was very worn, so that the belt was bottoming and not able to transmit much power without slipping. This was just about visible in photo 3.

The range of speeds for the mill was seven rather than eight, as the slowest open speed was pretty much the same as the fastest back gear speed. The difference in speed from one set of pulleys up to the next was about 1.8, which I considered too much. To work out a better selection of speeds, resort was had to a spreadsheet. The top speed of about 600 rpm was kept, and after some



Ladle – old steel saucepan.



Mazak just poured into the mould.

playing around with pulley sizes on the spreadsheet, a useful set of speeds with a multiplier of around 1.6 was soon found across the whole speed range, although the slowest speed was now 25 and not 12 rpm.

A pattern was now made for the smaller mandrel pulley (photo 29) and then cast in zinc. My ladle – an old steel saucepan with a long stout bar handle, and the moulding boxes are shown in photos 30 & 31. Problems with shrinkage voids occurred, but I could not find any guidance in my books on foundry work to suggest a cure. The first casting was useless. A second casting worked much better with a much bigger conical outgate to provide a reservoir of molten metal to fill the shrinkage as the metal solidified (photo 32). A small radial void formed beneath the outgate cone, which was bored out and a tight fitting plug was turned up from



Second mandrel casting.

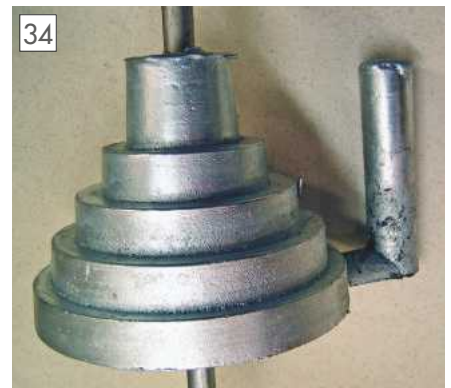
the ingate sprue with a thread on one end. This worked so well that it is hard to see where it was fitted.

Thinking about this problem, and the fact that the Picador pulleys are hollowed out under the two larger pulleys suggested to me that if a pulley could be cast with a core print, this would reduce the amount of metal to be machined out and also reduce the volume of metal when cast, which should reduce the risk of shrinkage voids forming. It was also decided to cast the second, and larger idler pulley, with its axis vertical rather than horizontal (photos 33 & 34). A length of 1/2 inch diameter aluminium tube was used as the core for the shaft hole to further reduce the risk of voids forming. This worked quite well with only a small void forming around the aluminium tube at the top of the casting in the outgate sprue. This machined out okay.

To be continued...



Idler pulley casting showing cast hollow.



Idler pulley casting. The ingate is on the RHS.

On the **Wire** **NEWS** from the World of Hobby Engineering

J-B Weld

The original 'J-B Weld' is a steel reinforced two-part epoxy with a tensile strength of 3960 PSI. It is slow setting (around 25 minutes) and taking about a day to fully cure as you might expect from their highest strength epoxy. It can withstand temperatures of up to 550 Fahrenheit (287 Celcius) making it suitable for repairs subject to very demanding conditions. It can be drilled and tapped, and one well-known use of it is repairing cracked castings, even cylinder blocks.

J-B Weld is often mentioned on the www.model-engineer.co.uk forum because of its high-strength and high temperature performance, but it seems many of us are less familiar with other products under the JB weld umbrella. Here are some of their other adhesives:

KwikWeld is the fast-setting version of the original steel-loaded epoxy. Still with a strength quoted as 2424 PSI, it sets in six minutes and cures in 4-6 hours. It can handle boiling temperatures, but not superheated steam. Kwik Weld is also available in a dual-barrel syringe for convenience in use.

ClearWeld is another dual syringe epoxy that sets in just five minutes but needs an overnight cure. Its strength is between the other two epoxies, but use the steel-loaded types if you want temperature resistance.

Perma-Lock is a thread locking compound, available in high-strength and medium strength formulations. The medium strength type can be dis-assembled with hand tools but the high-strength version requires the application of heat as well.

J-B Weld Clear Silicone sealant and adhesive and Ultimate Black gasket maker and sealant are high performance 100% silicone room-temperature vulcanising sealants.



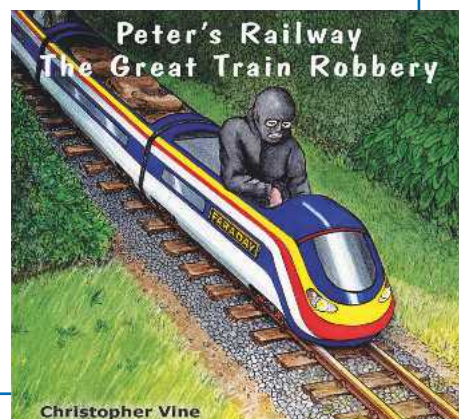
Belt Drive Mill from Amadeal

The AMAT25LV milling machine has recently been introduced by Amadeal. It combines belt drive and a 1kw brushless motor. The AMAT25LV also features a 700mm table, a 0-3600rpm spindle speed as well as a choice of MT3 or R8 spindles.

The mill is priced at £1190 including VAT and UK mainland delivery (except Highlands & N.I.). Further details on Amadeal's website www.amadeal.co.uk or call 0208 558 4615.

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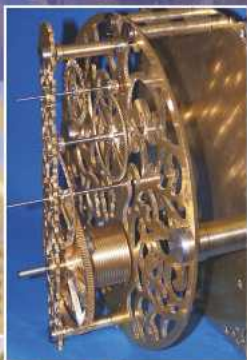
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The Mini-Lathe by David Fenner

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Mini-lathe Tools and Projects by David Fenner

This book follows on from Workshop Practice Series No. 43 and presents a series of projects which are intended to extend the versatility of this little machine. In some cases, additional machining capacity will be required, which some readers may find at their local model

engineering club. The book covers the Mark 2 Mini-Lathe, and specific tools such as the radius turning attachment, the tailstock and the dividing head, and includes techniques such as taper turning and knurling.

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One Man and his Lathe

Howard Winwood and his Amadeal AMA210VG Lathe



The Amadeal 210VG lathe.

Metalwork was my favourite subject at school and was always on a Wednesday afternoon. As it happened I did not go into that form of engineering, but instead was sent off to become a telephone engineer in the form of a three year apprenticeship, and had 33 happy years with what is now BT.

Having taken early voluntary retirement at the age of 50 from BT, the rest of my working life being spent at Sheffield Chamber of Commerce, teaching IT courses and looking after all the IT and telephony infrastructure, which lasted three years, the other twelve being spent at South Yorkshire Fire and Rescue, looking after the wide area network and the telephone systems.

The lathe cravings were diminished somewhat by delving into computers, starting in the mid to late seventies, at which time I was also well into amateur radio and R/C model flying. I just could not afford another hobby!

So, enough about myself, why the AMA210VG lathe? Lots of advice from various forums would have you go for something second hand, usually ex-industrial or from a college or school weighing upwards of 500kg. For someone who knows what they are looking for, that may well be good advice (you will

eventually realise that it is indeed very good advice, just inappropriate for a beginner as there are too many pitfalls).

Now there are lots of mini lathes from lots of dealers in lots of different colours but all are rebadged versions of lathes from a couple of manufacturers in China. The quality of manufacture is down to the customer's (dealer's) request of price or quality, and you have no indication when buying other than the dealer's reputation. A search on the internet will reveal who has the quality kit rather than the cheapest and like anything in this world, you (usually) get what you pay for. Most mini lathes come under the banner of 7x12 or 7x14, the next major step seems to be to the 9x20 size which are a lot bigger and heavier, the AMA210VG lathe is 8x14, slap bang in the middle (**photo 1**).

So, why be awkward and chose an 8x14 lathe? Well it is down to space and price really. I have a rather small workshop (one of my many inadequacies) which is 8ft x 6ft. I wanted to get the largest lathe I could fit in and still have some room to work, bearing in mind future purchases such as a mill/drill, bench grinder and so on. A 7x14 would fit in easily but a 9x20 would not, so why not go for the 7x14? So, why not follow the crowd and get a 7x14 mini lathe? Well the choice is staggering, but based on size is everything, I

Having decide some 18 months before my 65th birthday that on that date I would be retiring on a permanent basis, I decided to fulfil a lifetime ambition to purchase a lathe and have a go at making something out of metal.

measured and re-measured my workbench layout umpteen times to see what the biggest lathe I could fit in and still have room to use it.

So it would have been a 7x14 were it not for searching on the net and coming across the 8x14 from Amadeal. There is another dealer who sells a similar lathe but I chose to go with Amadeal as they seemed to have a good reputation, which is very important when you don't have much of a clue about what you are buying (an absolute beginner when I bought the lathe).

The 7x14 mini lathe usually weighs in at 45kg (roughly), the 8x14 from Amadeal weighs in at 75kg, and on the basis more weight = more metal = more rigidity it should be a better choice. As for physical dimensions, a typical mini lathe would be 770 x 320 x 300mm, the AMA210VG being

840 x 390 x 470mm, not that much larger but somewhat heavier.

As it happens, I had actually reduced my choice to 2 lathes, the Warco WM180 and the AMA210VG.

The WM180 is also a 7x14 lathe but much beefier than a typical mini-lathe, weighing 70kg and just a little smaller in footprint than the AMA210VG, the WM180 having the advantage (at the time of looking) of a lower price, the AMA210VG having the advantage of a larger swing over the bed. As it happens, the WM180 was awaiting new stock. When the WM180 was back in stock, the price had gone up. The AMA210VG was now the one for me. So, out comes the credit card, an order placed with Amadeal for the lathe, a 4 jaw chuck, face plate and fixed and travelling steadies.

The face plate was out of stock, but the rest duly arrived via courier and was unceremoniously dumped in the middle of my drive and left there. I managed to drag the crate up a slope into my garage and after a few minutes rest and a bottle of beer, cut the banding straps and removed the top cover to look at my new acquisition (toy!)

No chance of lifting it on my own without incurring a rather high pitched voice, I rang my number 2 son for some extra muscle power (number 2 being closest of my three boys at the time). Unbolting it from its travelling enclosure, we managed with a lot of puffing and panting to get it in place in my shed, oops! Sorry workshop.

I had a rather thick wooden shelf going spare that was just the right size to go under the lathe, and bolted the lathe down through this and the workbench top via the mounting points at either end of the lathe. A quick wipe down with some paraffin (no Chinese red chicken fat to get rid of here) and switch on – hey presto everything works, always a good feeling.

The lathe did come with a test certificate showing all the various measurements and tolerances so giving one a sense of confidence that the lathe should be reasonably accurate. I use the term accurate, rather loosely as Chinese lathes are built to a price, compared to the usual industrial lathes, but as I was more likely to be the limiting factor rather than the lathe I moved on.

I did not strip down the lathe and fettle it as most, more experienced users would probably do as I did not have the confidence. I soon learned that gib strips need to be adjusted and things generally tightened up when in use but soon got some metal in the chuck and proceeded to have a go as they say. As I have used the lathe more and more, I have become familiar with its faults (few and far between I might add).

The lathe has worked well for me as a beginner, leaving the chuck key in, trying to take too large a cut, too much speed etc. and has given sterling service. It has not let me down, I have not blown a fuse despite many occasions the machine has stalled due to my inexperience, the fault light has never come on, the motor has never overheated despite some long usage times. One hears many tales of blown circuit boards at £100+ a time but not on this baby, thank you very much.

The lathe comes with a plastic carrier box containing the set of outside jaws for the 3 jaw chuck, two centres - M2 and M3, a set



The accessories supplied with the lathe.



The lever locking tailstock.

of metal change wheels, spanners, hex keys screwdrivers and oil bottle (**photo 2**).

The lathe has a two speed gearbox and an electronic variable speed controller. The gearbox gears are also metal running in a bath of oil, no indication of how much oil there should be, so when I eventually spotted the sight glass window, I topped it up to the top of the window.

The change wheel gears are set up from the factory for slow longitudinal feed, changing these gears for cutting threads is something of a challenge but is not too onerous. Getting everything to mesh and run quietly proved to be quite easy, gradually engaging the banjo with the gears attached until the noise just quietsens with no binding.

I must note at this time that safety is paramount judging by the number of safety switches on the lathe, they seem to be everywhere.

So far so good, not too many problems until I start oiling the various points as per

the manual (I will come onto the manual itself soon!) Fill supplied oil bottle, push nozzle into ball valve oiler, ball disappears inside oiler, never to be seen again. Oh dear! (Or words to that effect). Still, they are not expensive so order 10 off new ones and replace the ones supplied.

Try as I might, I can only think of one other niggle (apart from the manual!) and that is the tailstock lever locking device (**photo 3**). This soon adjusts itself so that the lever no longer locks the tailstock to the lathe bed, and is very fiddly to correct as only a very small movement of the locking device is required. An eighth of a turn is the most needed, but hard to do with fingertips under the bed of the lathe.

Now, just what you have been waiting for, the manual. The manual is actually quite comprehensive showing an exploded view of all the parts, it is just a pity it does not relate to this particular model but the previous one (spoil a ship for a h'pence of tar).

The specification sheet is quite comprehensive; hardened and precision ground V-way bed, spindle bearings are precision taper roller bearings, right and left hand thread cutting is available!

Hold on a minute, right AND LEFT hand threads, nay lad! Not on this lathe as it stands. I have asked the question as to how we get left hand threads, but have not had a reply. Without some form of extra gearing to reverse the direction of the longitudinal feed then it ain't going to happen, unless YOU know otherwise of course. (Amadeal's website states that left hand thread cutting is possible *with modification* – Ed).

The lathe did come with a test certificate showing all the various measurements and tolerances so giving one a sense of confidence that the lathe should be reasonably accurate.

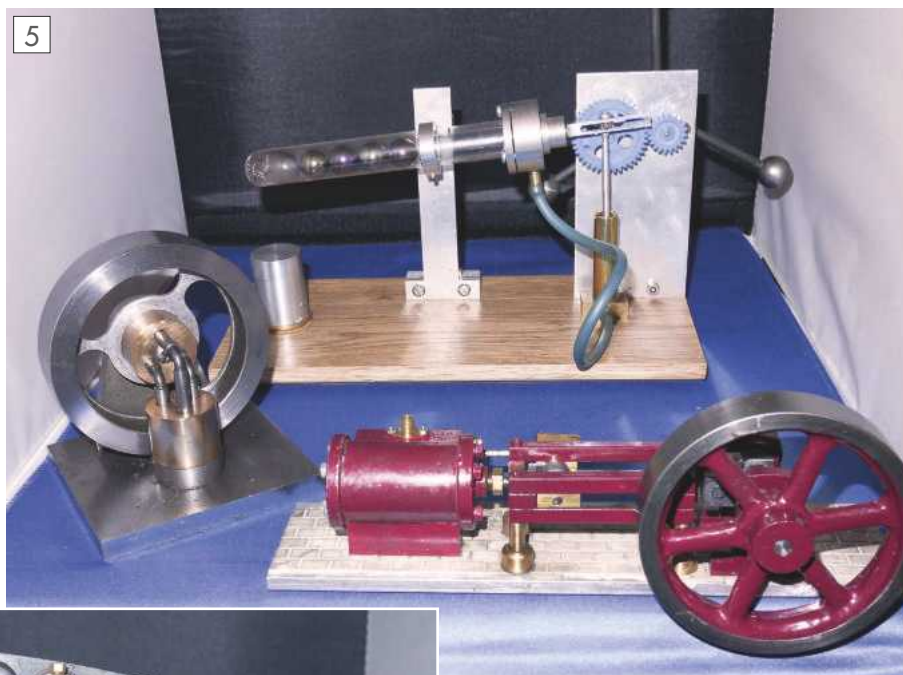
By the way, I chose the metric version and am glad I did. Being brought up on imperial measurements it was a difficult choice, but proved to be the correct one in the long run.

I have done a couple of mods to the lathe since purchase, remove safety shield over chuck, it was always in the way and did not prevent showers of swarf, usually brass, from covering me from head to toes. I know! I know it is there for a reason, I still have all my digits even though I am only using two to type this up on the computer.

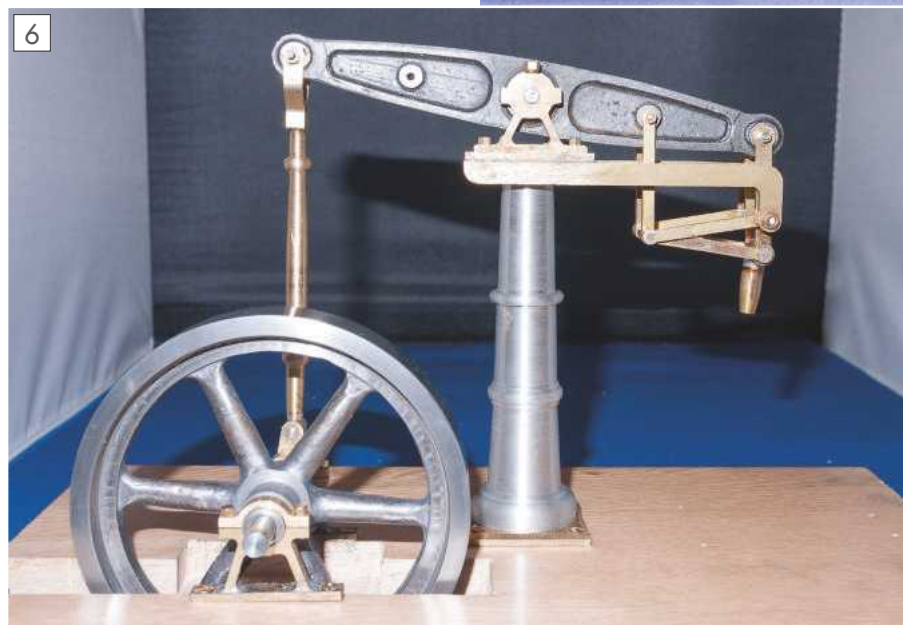
Next mod was to the tailstock by adding a cheap cut down digital calliper to measure drilling depth and so forth and have found it to be quite useful in practice. The other mod I have done is to purchase



Some models made on the lathe, including a low detail Stirling engine.



As well as this mill engine, the author has made a number of less conventional engines.



The current project on the lathe is this beam engine.

a QCTP (quick change tool post), this was also from Amadeal, together with some additional tool holders (I must get some more...) I just do not know why I did not do it sooner. I don't think it needs much else doing to it but might put brass gib strips in at some point if I get bored.

As to using the lathe, I have enjoyed making a number of models with it, as well as the various modifications (**photos 4 to 6**). Would I buy it now, seeing what is on the current market? Well, yes I would, as I think it has a unique place in the lathe lineup, certainly one that fits my need exactly. It has done all I could ask of it without too many bad noises. One soon learns what it can and can't do and learns to live within its limitations. ■

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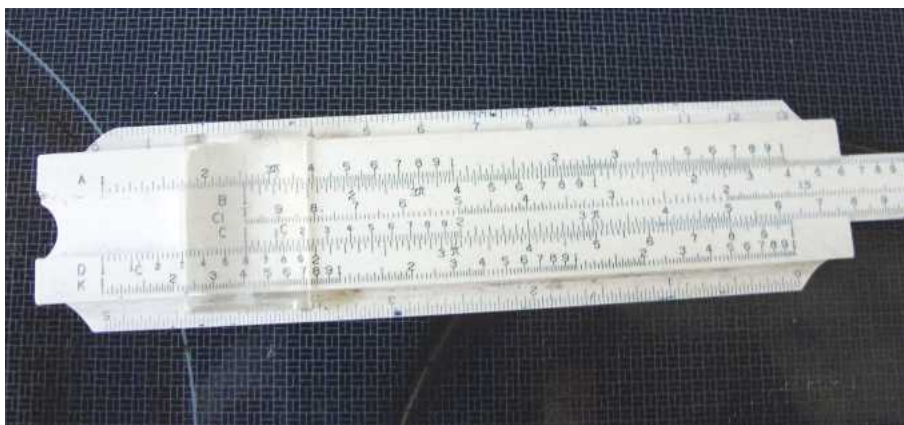


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Translation Tips 1

Neil Macnaughtan may be interested in using a slide rule to give conversions imperial/metric.

By setting up the conversion 25.4 mm to 1 inch, any measurement can be converted and many different measurements can be compared and converted instantly. By using a small slide rule (the photo shows a 7 inch rule) this can be kept to hand or in the pocket and carried around.

Depending on eyesight, a magnifying glass or a larger (12 inch) slide rule may assist (or both). A program can be set up on computer or scientific calculator if he has the relevant knowledge to carry out a similar function.

Kenny Mckenzie, Lenzie

Translation Tips 2

Dear Neil, a comment on the letter from Neil Macnaughtan. Why not just change the leadscrews on the top and cross slides for metric ones? Myford made a metric version of their lathe so these parts exist as standard parts. It would saved having to calculate the metric-imperial conversion, and avoid problems with getting it wrong sometimes. It would obviously be more expensive than a calculator, but less liable to error.

My lathe was converted by a previous owner. I believe that in the Myford metric version the leadscrew is still imperial at 8 tpi, so I have no idea how its motion is calibrated. On my machine an external gearbox has been added so that a dial shows movement in metric. The optional

handle on the end of the leadscrew has had a scale calibrated in metric added, but obviously with a discontinuity where the scale goes from 25.3 back to 0 mm. For screw cutting a special series of gears is available for normal lathes. With a quick change gear box I do not know what the position is. In my case the only threads I have needed to cut have always been imperial so I have not had to look into this aspect.

Ellis Boardman, Cheltenham

Translation Tips 3

Dear Neil, I write in reply to Neil Macnaughtan's letter in issue 230 regarding a pocket sized device which will convert between metric and imperial measurements.

My solution would be to download a suitable app to his mobile phone should he have a suitable device. If not, older Android based phones are cheaply obtained on eBay - you wouldn't even need to have it as a phone - as long as you have a suitable cable you could connect it to a PC and download the app via the PC. Another less flexible solution would be to buy a programmable pocket calculator and setup your own formulas for the relevant conversions. The mobile phone solution could be used for lots of engineering based calculations etc. with the right app.

Simon Cornish, by email

What's in a Name?

Dear Neil, due to illness I have not been keeping up to date with the workshop, however, my attention was drawn to the article 'What Does STEN Stand For?'. It stands for Shepherd and Turpin, the 'EN' for Royal Ordnance Factory Enfield. During WW2 it was called the 'Woolworth Gun'. It was originally developed by the Italians as a twin-barrelled light machine gun known as the 'Perino' during WW1. It was hoped it would replace the Lewis light machine gun, but the war ended. The German ordnance developed it for infantry use as the Mod. 18 and finally the Mod. 28 for the civil police. This weapon was copied and manufactured by Lanchester. This was used by the Royal Navy, I remember it as late as 1954 used by the Royal Scots Regiment.

The STEN replaced the Thompson sub-machine gun .45 inch calibre in the home guard. There were several marks of STEN, up to five and other variations of it. Involved were Pratchett, Shepherd and Turpin and it led to more sophisticated weapons using the blow-back principle, notably the Sterling. The STEN did away with the curse of British weapon design - over engineering. I remember it as a robust weapon, easy to clean and maintain, simple. Certainly worth the alleged 7/6 cost!

James W. Milne, Edinburgh.

For a range of perspectives on the name 'STEN', see the forums at www.model-engineer.co.uk

Linking Up

Dear Neil, the magazine is fantastic with so many interesting items each month. This letter is a request to find out if there are other model engineers in my area.

I live in Central Scotland in a small village called Condorrat, 10 miles East of Glasgow. I became interested in model engineering away back in the 80s before the first copy of *MEW* was published. I bought a second hand super 7 and I designed and built a 5 x 4 inch view camera similar to a Sinar F2. My project was actually published in *Amateur Photographer* in the late 80's. I remember I was collecting something from Neil Hemingway and I had the camera in the car that day. He was fascinated with it as he was also very interested in photography. A view camera has

movements in all directions and it was a great subject to design and build.

As seems to be the norm, I met my wife, we had our daughter and now that I am 63, I am semi retired and have more time for model engineering again. I had a good friend who was older than me and we always kept in touch with projects but Jim passed away last year. I really miss him now. Not that we met every week, but it was great to talk about model engineering either in person or on the phone. He worked as a lathe instructor in the South of Scotland Electricity Board training centre in Cumbernauld before he retired. I was wondering if you had other model engineers on your contact list in Central Scotland that would be interested in meeting up for a talk.

I know there is a club in Kirkintilloch but I am more interested in making tools and additions to improve my Super 7 rather than running a model railway. I have an early Super 7 SK8304 which was made in 1959, almost as old as me. I literally took the whole lathe apart and rebuilt it before making my view camera. I learned a lot about how a Myford works and that helped me with the design of the camera.

Mervyn Karwot, Condoratt

Hello Mervyn, the Scots seem to have taken over Scribe a Line in recent months, so I'm sure you will find some fellow model engineers! May I suggest that anyone seeking to join up with other hobbyists in their area post a message on the forum at www.model-engineer.co.uk

Neil

Motor Maintenance

Dear Neil, to mount a hardened shaft (as in commutator skimming, MEW 229) which isn't centred; make a centred Delrin (acetal) cap, press onto shaft and support with a live centre. A dead centre could also be used by changing the cap material to self-lubricating Nyloil. Delrin could be used for machining tube or pipe by fitting a centred plug in one end i.e. if no pipe centres are available. Delrin is so versatile, another use is for proving CNC programmes.

If Ted Fletcher (Rotating Chuck Adaptor, MEW 229) left the armature bearing on the shaft and gripped it in the chuck this would prevent the chuck from rotating, meaning less mass rotating. An adjustable adaptor could have been made to fit the bearing alone. I've skimmed large motor commutators in the past using normal cutting tools which tends to make the commutator copper overlap



Scrapyard Treasure

Dear Neil, I was having a look around a scrap yard where I live and I came across a most unusual chuck holding a sack truck up. It is a Charles Taylor made in Birmingham. It has unusual jaws as you can see. I had to get a new back plate for it from Arc Euro to fit my Myford ML7 lathe.

I am a 72 year-old novice. I have a general woodturning lathe which I use a lot and also a smaller one which I make pens with and 'toadstools' etc. I use the metal lathe to make parts for the wood lathe. I have included pictures of both lathes, I hope it is of interest to readers.

Keep up the good work with MEW.

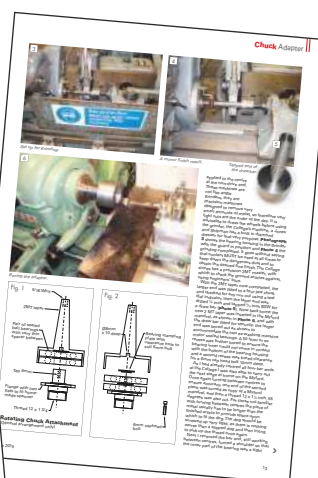
David Ravenscroft, Lymm, Cheshire.

Thanks for your letter David. That's a marvellous old chuck, I particularly like the extended tips of the jaws – Neil.



the mica when machined. By using a carbide tipped parting-off tool leaves a better finish and more distinct mica gaps –unorthodox, I know.

Doug, Melrose



Magnet Warning

Dear Neil, I was reading the recent article about Rare Earth Magnets and thought the readers should be made aware of the dangers of these button magnets. I use these button magnets, and with a recent purchase of magnets came the warning that if a child were to swallow two of these magnets the result could be life threatening. Having suffered an intestine condition similar in outcome to the swallowing of two magnets I am more than aware how dangerous they could be to a child.

I do hope you will be able to publish a warning about the dangers.

John Harris, Maidenhead

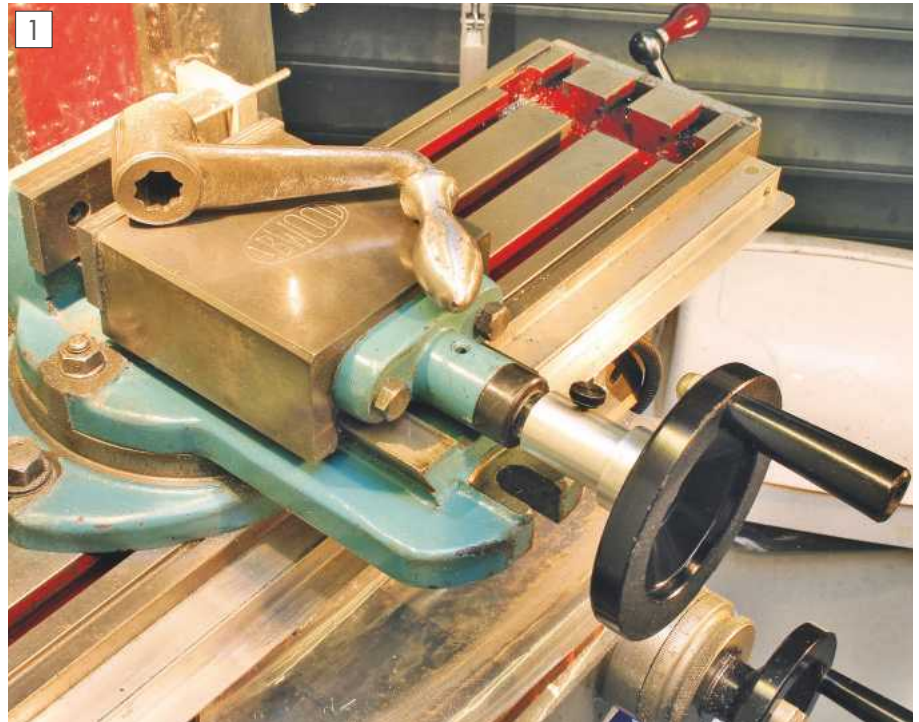
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An Alternative Handle for a Machine Vice



Ken Hall substitutes something better suited to his needs.

Substantial machine vices are often supplied with a massive L-shaped handle. This is fine for heavy clamping, but unsuited to more delicate work. A wheel-type handle made from a junk box find has proved to be very useful (**photo 1**).



Old and new handles.

The old Abwood vice used on my mill has a heavy cast iron L-handle with an 8 splined hole to fit the square end of the vice screw. The splines allow some choice of the angular position of the handle when clamping a workpiece. In fact the weight of the handle is too great if only a very light clamping force is needed. For example, if I need to slide or swivel the workpiece between the jaws using my fingers, the clamping force needs to be just enough to allow movement. The heavy handle always swings to bottom

dead-centre, which often either clamps the workpiece, or leaves it loose, despite trying different engagement of the splines. Sometimes I have removed the handle and turned the square shaft with my fingers to achieve the light clamping force I needed. If the vice needs to be opened or closed by a few turns, the big handle is an

ungainly thing to use. Again, fingers have been used for this movement.

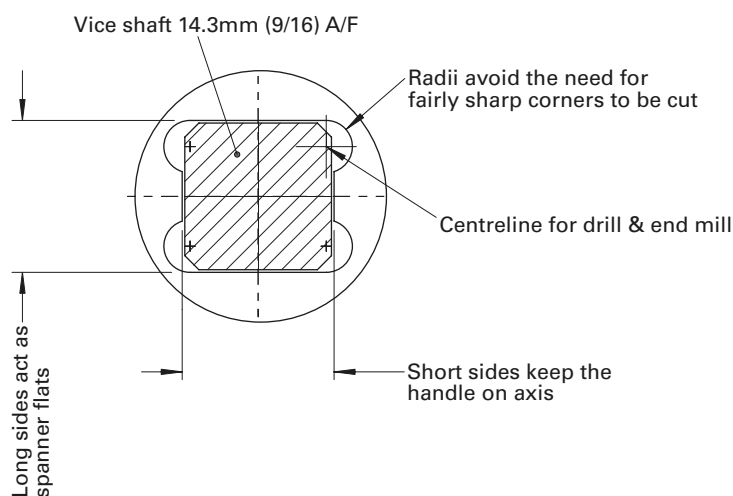
It occurred to me that a wheel-type handle would be free from the gravity effect of the L-handle, it would enable a fast traverse of the vice jaw and, if the diameter was reasonably large, a good clamping force would be available.

In the junk box was a battered compression-moulded disc handle, 100mm in diameter. The metal bushing in it was too small and too short to allow a suitable square hole to be cut in it. Obviously, the answer was to make an adaptor with a spigot to suit the handle at one end and a square hole at the other. The only difficult part would be making a blind square hole at least 1.5 times the width of the square (I hate wobbly handles, so I wanted a good length of engagement).

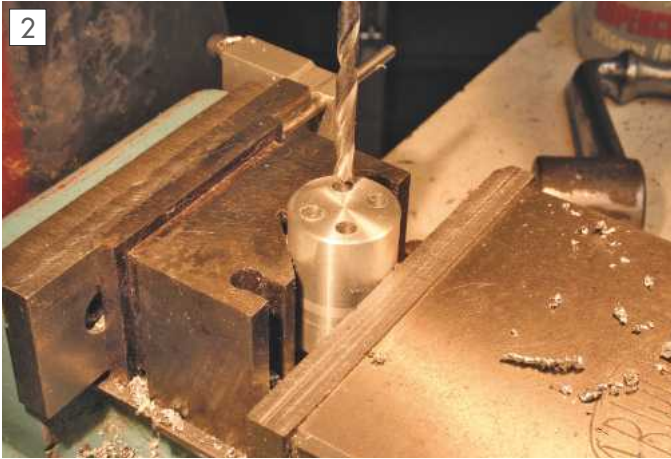
But was a square hole essential?

In view of the comparatively low torque involved it seemed unnecessary to drive on all four faces of the square shaft. After all, open spanners use two faces to tighten hexagonal fasteners. I decided that aluminium alloy would be quite suitable for the job as well as being easy to machine. The hole would need a small diameter long series end mill to finish the flats, so the cutter finally chosen was 5mm diameter with a cutting length of 32mm.

Fig. 1



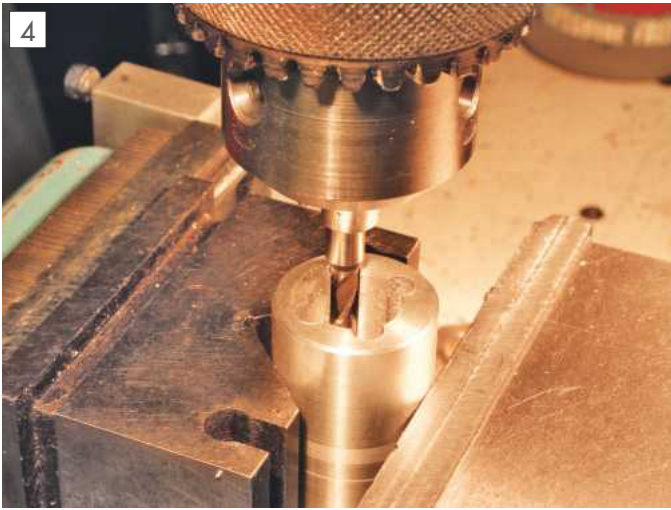
Cross Section Of Shaft And Adaptor



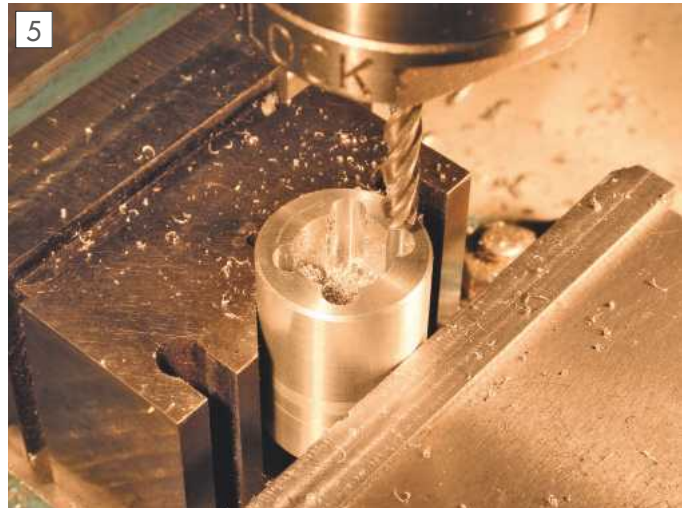
Drilling the starting holes.



Checking the bore using a telescopic gauge.



Locating the adaptor using a drilled hole.



Milling out the 'square'.

It occurred to me that a wheel-type handle would be free from the gravity effect of the L-handle, it would enable a fast traverse of the vice jaw and, if the diameter was reasonably large, a good clamping force would be available.

Figure 1 shows a cross-section of the hole that could be partly or totally machined on my turret mill. The need for a fairly sharp-cornered square or spline has been avoided by an easily machined radius in each corner. To reduce the time spent milling, most of the metal removal was done in the lathe.

After turning the adaptor blank, this was transferred to the mill, and held in the vice using a vee block which was located against an end stop attached to the fixed vice jaw. Having centred and zeroed the blank to the spindle axis, four 4.5mm holes were drilled on the axes of the final positions of the 5mm cutter, **photo 2** shows the set-up, just deeper than the working depth of the finished hole.

Leaving the spindle in line with the last hole drilled, the adaptor was put back in the lathe and bored out to the across-flats dimension of the square (**photo 3**).

Finally the bored adaptor was returned to the mill. As the machine spindle was

still in line with where a drill hole axis should be, I put a 4.5mm slot drill in the chuck and engaged this in the remains of one of the drilled holes (**photo 4**). Then with the vee block against its stop, the vice was gently tightened, the slot drill removed and the vice firmly clamped. This positioning of the adaptor was not too critical as there was still 0.5mm to come out of the holes.

With the 5mm end mill in the Autolock collet chuck, the drilled holes were opened up to their full depth (**photo 5**). Then the rest of the metal was removed with light cuts in three stages of depth, leaving 0.1mm for the final cut on all faces. The telescopic gauge was used again to check the size and for taper. Finally I ran round all the faces at the nominal finish co-ordinates at the full depth of the hole.

The result was better than my expectations and quite usable.

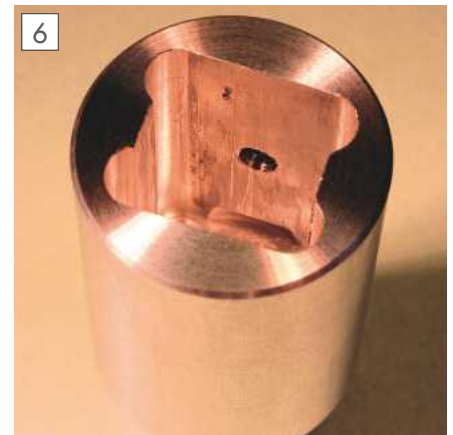
The knurled clamp screw shown in photo 1 was added as I intend to leave the

handle on most of the time, and this prevents it being pushed off accidentally.

The assembly of the adaptor to the handle involves only the degreasing of the mating diameters and the application of a few drops of a suitable grade of adhesive, which in this case was a strong Loctite.

So far as the achievable clamping force goes, tests using both hands on the rim of the wheel, and then swapping to the original handle, showed that the new handle is nearly as effective as the old one. Except for the few times when the maximum clamp force is needed, the new handle will do everything and much more conveniently.

I should have done this years ago! ■



The finished adaptor.

Mill spindle slow speed friction drive

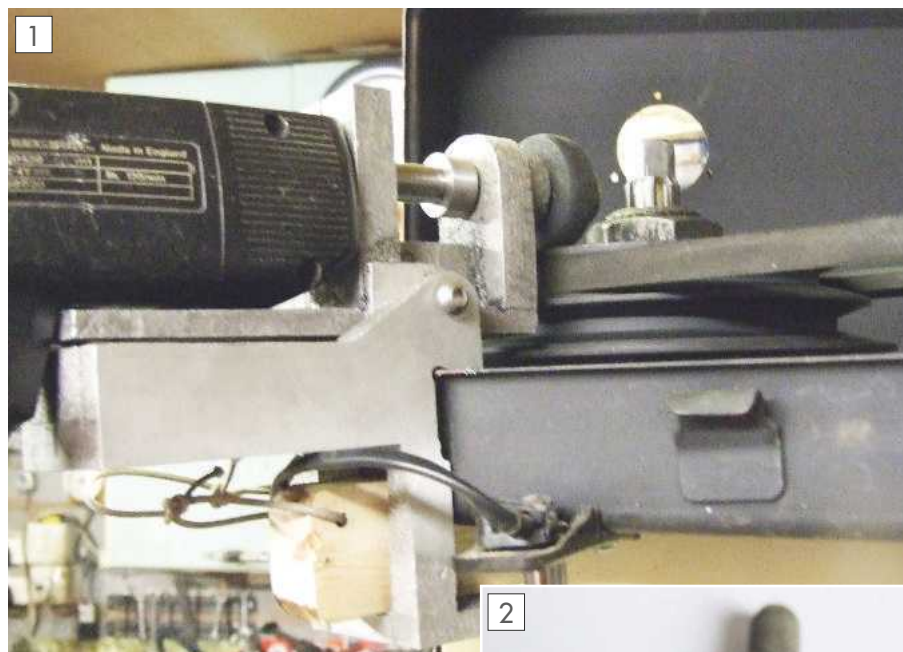


Malcolm Parker Lisburg takes an unusual approach to turning his mill very slowly.

Centring of the rotary table on the milling machine, using the DTI in the chuck, can become tedious. You need to either use a mirror or peer round the back as you swing the DTI. A recently received refund on a claim for a delayed airline flight that occurred in 2009 meant that funds were available to purchase a long time coveted coaxial centring indicator. This was ordered from a well known supplier on eBay. The eagerly awaited indicator arrived, but bits were missing. The supplier despatched the missing parts quickly.

The new toy was mounted in an MT3 collet, which means the Jacobs chuck or collet chuck are at the same working height as the coaxial indicator. My mill is an Axminster supplied rebadged Rong Fu RF25 mill drill so is belt driven. The maximum speed for using the coaxial indicator is the slowest speed that the mill will run at. This requires changing the belts to different pulley positions, removing both belts if the current chosen speed required the motor belt in the upper position. Being quite tall, the mill table is set at a comfortable height for me, meaning tip toes are needed to change the belts if the mill head is high up the column. Using the coaxial indicator for the first time highlighted the need for another solution to provide a slow speed drive for the indicator.

Being a squirrel that has retired, but hasn't retired from squirreling, the stores were searched for a suitable solution. A vintage 2.4 volt Black and Decker screwdriver was amongst the items found. The batteries of which had long since died. The screwdriver was disassembled and looking at the permanent magnet motor I



Attached to the mill.

Motor gear puller.

realised that I had seen the same motor type in the squirrel stores. A 12V booster pack tyre compressor. This was retrieved and both motors were compared side by side. Both were the same physical and the same shaft size but the gears were different. The gear from the screwdriver motor needed to be removed with a puller and pressed onto the compressor motor. I did not have a puller that small. Out of the squirrel stores came a broken bicycle chain link extractor with hardened screw and extractor pin. The end of the extractor casting had broken off but a lick with the mill gave a flat surface onto which a slotted plate could be mounted. The end of hardened screw was turned down with a carbide tipped tool to just under 3mm, the size of the motor shaft (**photo 2**).

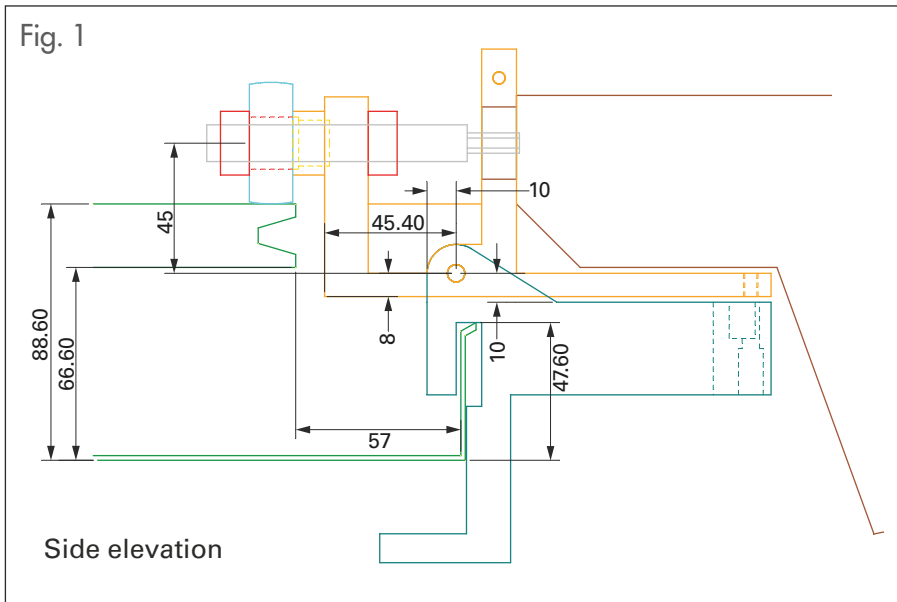
A little heat was applied with a gas torch in case locking compound had been used on the brass gear and the re-purposed link extractor easily removed the gears from the motors. The screwdriver gear was again heated and pressed onto the 12V motor shaft. The screwdriver was re-assembled, discarding the batteries and switch and a 2 pin socket added to the



handle to power it externally. The screwdriver was then powered from a car battery and the quiescent current measured. This was 2 amps so an old 12V 4A laptop supply could be used to power the screwdriver. The label on the screwdriver said 240rpm and the new motor gave the same rpm.

The screwdriver was to power a rubber pinch wheel which pressed onto the face of the mill spindle pulley. The pinch wheel was made from a discarded hard rubber boat keel roller. This is easily machined and a crowned roller was turned and bored on the lathe. Measurements of the belt and pulley shroud, pulley face height and diameter were taken together with the screwdriver outline and a CAD elevation

Fig. 1



drawing made to these dimensions (**fig 1**) As speedy attachment was desirable it was decided to hold the attachment in place with a wooden wedge.

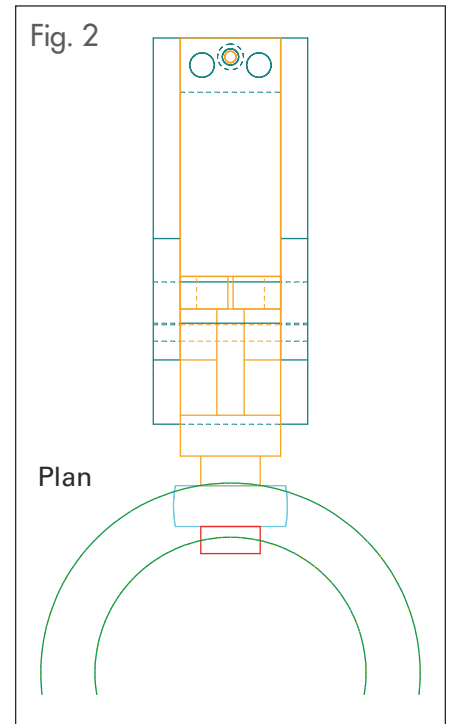
The plan view (**fig 2**) was then drawn and copies of the drawings were made to give the outline of the patterns for cutting foam for the lost foam casting. These were printed onto card, cut out with a scalpel and stuck to the foam blanks with Pritt Stick. The outline of the card was followed with the hot wire cutter; an allowance had been made to the card patterns for the hot wire cutting kerf. If a cast face was to be machined, 2mm was added as a machining allowance. The foam used is extruded polystyrene structural foam, which is denser, firmer and gives a better surface finish than white expanded polystyrene. It can also be sanded with rough sandpaper. The pieces of foam were glued together with spots of hot glue from a temperature controlled hot glue gun set to 130 degrees C. Ribbons of quick set PVA glue were added to the right angle corners to form fillets. Sprues, runners and blind risers of white expanded polystyrene were added and the foam patterns buried in dry sand. A header reservoir, made from two pieces of tube, split and hinged surrounded the foam sprue and molten aluminium was poured in quickly until it

overflowed the header. The castings were allowed to solidify, extracted from the sand and sprayed with water to cool them rapidly. The aluminium cast was from scrap boy racer alloy wheels and rapid cooling makes the casting more machinable. No coating was applied to the foam and spraying water on the hot casting causes the sand to loosen and fall off (**photos 3 & 4**).

Sprue, runners and risers were sawn from the casting with a sabre saw recently purchased from Aldi. This certainly takes the arm ache out of cutting 25mm sections. The rubber pulley mandrel and retaining bush were made by recycling two scrap gear blanks which were gear cutting failures. The rubber pulley mandrel was machined 0.05mm larger than the pulley bore and the pulley pressed on with a little belt and braces superglue. These gear blanks were already reamed to 1/2 inch (12.7mm) so that became the shaft size. A piece of silver steel was reduced to 7mm diameter for 18mm to couple the shaft to the screwdriver. This round section was then milled hexagonal to be an easy fit in the screwdriver output socket which is the standard 1/4 inch hex (**photo 5**).

The raw castings were machined. The screwdriver clamping casting (**photo 3**) was machined to take the screwdriver

Fig. 2



boss and a 1/2" bore Oilite bush for the shaft. Fitting instructions for Oilite bearings recommend press fitting with a mandrel in the bore of the bush. Rather than press fit the hole for the bush was machined 0.025mm undersize and the casting was then heated. This enabled the Oilite bush with a piece of silver steel in its bore to just drop into the casting hole with ease. The casting was left too cool with the silver steel in place. This resulted in a good bearing fit without the need to spoil the oil bearing surface of the bush by machining.

The mount for the screwdriver boss was split with a slitting saw and a cross hole drilled, one half clearance and one half tapped M6 for a boss clamp screw

Drive pulley and shaft.



Raw casting, screwdriver clamping casting.



Raw casting, with sprue, mounting casting.

The mounting casting (photo 4) was then cleaned up and the gap between the sides fly cut so that the screwdriver clamping casting would fit between with a little clearance. The pivot holes were first drilled through the mounting casting and the screwdriver casting was clamped to it and the pivot screw holes spotted through. The screwdriver mount casting was then drilled and tapped at the spotted markings.

The drive was now assembled and mounted on the mill. The mill motor belt tension was released so the drive could take place easily at whatever drive speed pulley selection was currently chosen. The whole assembly just hooks over the edge of the mill pulley shroud. As a quick attachment and release a wooden wedge was used to hold the drive against the pulley shroud.

Sprue, runners and risers were sawn from the casting with a sabre saw recently purchased from Aldi. This certainly takes the arm ache out of cutting 25mm sections.

A wire strap was passed round the end of the screwdriver mount casting and a digital luggage weight scale hooked under the strap. Power was applied to the screwdriver and the digital luggage weigh scales lifted to determine what force was required to give reliable pulley friction drive as the rubber friction pulley was pressed against the spindle pulley. This was determined to be 2Kg. Springs were now selected from the squirrel store and the rate of them determined with a free programme by Mid-West Springs that was downloaded from the web. You can download it from this link: <http://tinyurl.com/os2qb6t>

In addition to compression springs it does the calculations for tension and torsion springs (**photo 6**) but requires

Spring programme output.

Windows XP or a virtual XP in Windows 7 or 8. Being a programme from the USA it only works with Imperial measurements (photo 5). Many spring parameters are calculated by it, but the parameters of interest are spring rate in lbs/inch and the height when the working load is applied.

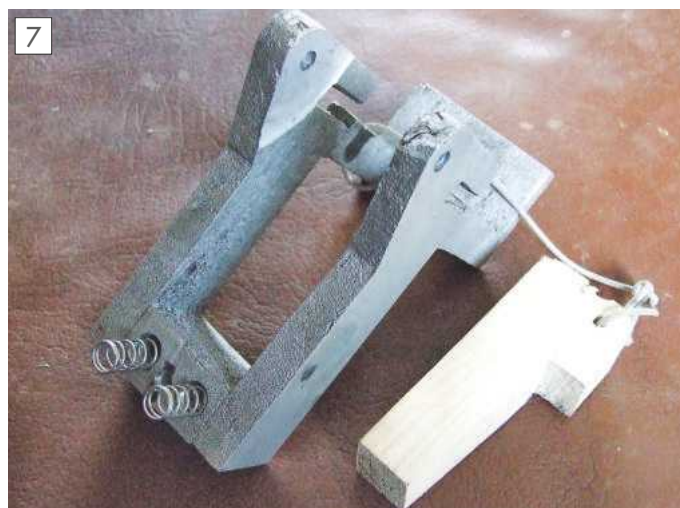
A selection of springs were measured, many were too strong, but two stainless springs from a hand wash soap dispenser of outside diameter 0.365 inch (9.2mm) with wire diameter 0.031 inch and free length 1.1 inch (28mm) require 2.5lbs to give a compressed length of 0.575 inch (14.6mm) so two in parallel will give more than the 2Kg needed.

The end block on the mounting casting was drilled 9.5mm, 12.4mm deep to give two pockets to hold and trap the two springs (**photo 7**). This depth gives the required spring length when attached to the mill. A further hole between these two

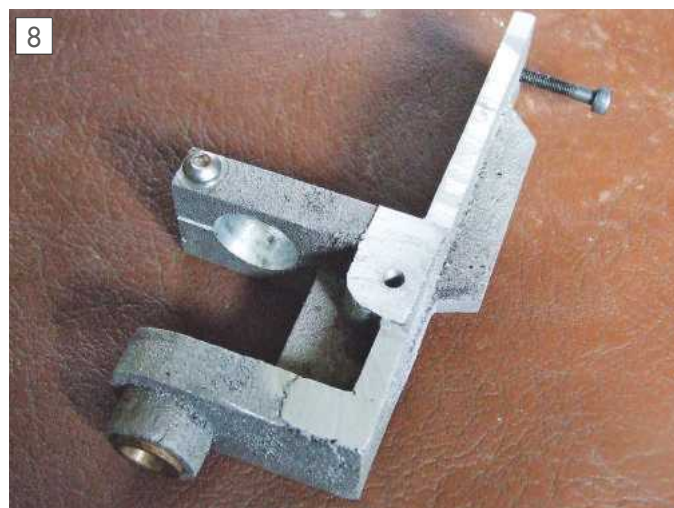
was drilled through for a good M5 clearance for a screw and screw head to limit the travel of the screwdriver clamping casting under the spring influence. The plate was drilled and tapped M5 to take the limit screw (**photo 8**).

The driver was assembled and ready for trial. The fingers, on the mounting casting, that hook over the pulley shroud were a little long to allow a quick fit so were filed down by about 1mm. The screwdriver is rather noisy, but handles loading without any slippage. The feeler on the coaxial indicator now rotates slowly enough to identify its position on the X or Y axis and then glance to the needle deflection and adjust it to a minimum for that axis.

It is now a pleasure to use the coaxial centring indicator drive. It takes only seconds to fit, much shorter than the time to remove the drawbar and MT3 fitting from the spindle. ■



Finished mounting casting, with springs and wedge.



Finished screwdriver clamping casting.



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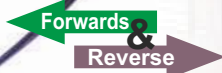
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REVIEW The Warco WM250V Lathe



Dave Fenner reviews Warco's latest machine aimed at the home workshop.

Background

A conversation with Roger Warren, Managing Director of Warco, resulted in the opportunity to borrow this new machine, and cast an eye over it. Longer term readers may recall that back in 2012, I was able to try out the WM240B, and it would be interesting to make comparisons. Whereas the earlier machine had been aimed at those seeking traditional simplicity, this new offering is a touch larger, comes equipped with a powerful inverter drive giving variable speed, a headstock gearbox with three thread/feed selections, and an apron assembly which has not only the expected half nut arrangements for threading, but also a selection lever for fine feed, both longitudinal and power cross feed.



Lathe as received on pallet, cling film hides packing case and boxes.

Package arrival

Delivery was made by a curtain sider lorry with tail lift, so that, using a sheet of 3mm steel as a ramp, it was straightforward job to use a pallet truck to shift the pallet into the workshop. **Photograph 1** shows the consignment, well wrapped in black clingfilm, which would give protection if exposed to prying eyes or weather. Removal of this then showed two cardboard boxes, containing the lighter weight stand on top, and the heavy machine in a wooden crate below.

Documentation

An operator's manual for the lathe comprises some 23 pages of operating instructions and 19 pages of parts lists and illustrations. Here I was pleasantly surprised by the clear presentation. Things have moved forwards a great deal from the 'Chinglish' booklets of yesteryear. Although the machine is supplied with the inverter package programmed and ready to plug and play, a separate instruction sheet and CD ROM are supplied for it. Also included is a comprehensive inspection test record (**photo 2**) giving ten dimensional tolerance checks, also a total of 34 electrical and other inspection criteria.

WM250V					
NO.	INSPECTION ITEM	DIAGRAM	TOLERANCE(mm)		ACTUAL
			PERMISSIBLE	ACTUAL	
1	Runout of spindle nose a radial plane b face plane		a 0.01 b 0.015	0.01	0.015
2	Runout of center		0.03	0.015	
3	Runout of spindle taper hole a spindle nose b 250 distance		a 0.015 b 0.03	0.015	0.03
4	Parallelism of center line of spindle to carriage movement a in horizontal plane b in vertical plane		a 0.03/250 b 0.03/250	0.02	0.03
5	Difference between two centers (higher at tailstock)		0.02-0.06	0.03	
WM250V					
NO.	INSPECTION ITEM	DIAGRAM	TOLERANCE(mm)		ACTUAL
			PERMISSIBLE	ACTUAL	
6	Parallelism of tailstock quill to carriage movement a in horizontal plane b in vertical plane		a 0.025/50 b 0.025/50	0.02	0.025
7	Parallelism of tailstock quill taper hole to carriage movement a in horizontal plane b in vertical plane		a 0.03/100 b 0.02/100	0.02	0.03
8	Parallelism of center line of spindle to top slide movement		0.04/50	0.03	
9	Radial runout of chuck		0.04	0.03	
10	Radial runout of ø20 test bar		0.06/100	0.06	

Dimensional checks on the inspection record.

Building the stand

This is composed of two supporting cupboard units linked by shelves and backplate. The backplate was assembled, then attached to each of the cupboard units. The shelves were then added, these being attached like the back plate, by Allen screws engaging captive nuts. The drip tray, was then laid on top, and would be retained by the three bolts used to bolt down the lathe. The general design of the stand gives an aura of quality, each cupboard unit having a drawer and two shelves, then two central shelves with rubber lining. The two cupboards have chamfered rather than square vertical outer front corners potentially being kinder to wayward knees.

Lifting the lathe

The weapon of choice here was my engine lifting gantry which has evolved over the years from a simple beam across a single garage, to a wheeled gantry carrying a Yale Pul-Lift lever hoist. The lathe instructions prohibit lifting by the spindle, so I chose to pass a strop through the bed, then add a light ratchet strap tensioned around the splash back, to keep things level, front to rear. The arrangement of strop and strap can be seen in **photo 3**. By moving the saddle and tailstock along the bed, it proved possible to keep the machine pretty level, left to right. The weight of the machine is quoted as 180 Kg or about 396 lbs, so a manual lift by say four strong men might be possible, but I think would be distinctly dodgy. For those who do not have the luxury of lifting equipment, my advice would be to borrow or hire an automotive engine crane, and thus make the lifting and positioning a controlled and safe operation even when working single handed.

Supplied accessories

As well as the 125mm three jaw chuck which arrives fitted, a similar sized four jaw and a 240mm diameter face plate are provided for alternative workholding. For working between centres, two dead centres are included, a 4MT for the headstock, and a 2MT for the tailstock. The machine comes rigged for the high speed range, with an additional belt to cover the lower range. Fixed and travelling steadies are included, as are a thread dial indicator, an oil can, set of changewheels, and tools (screw drivers, spanners & Allen keys). An unexpected inclusion is the pair

of tins of yellow and green paint to touch up any chips which might occur during commissioning or later use.

Transmission and Headstock

Undoing two knurled thumb nuts allows the removal of the belt/gear cover which is a sheet metal fabrication, and therefore probably less susceptible to damage than similar plastic items. The three phase motor is rated at 1.1 Kw, (i.e. twice the power of the WM240B) driven via an inverter from a domestic 13 amp supply. One criticism of inverter drive packages is that the internal fan on the motor can become ineffective at low speeds allowing the possibility of overheating. Here the motor has a separate fan cooling system (faintly audible at switch on) which ensures that the unit stays cool even at low speeds and high loads.

The pulleys allow two belt settings for the two speed ranges: low - 30 to 400 rpm (**photo 4**) and high - 150 to 2200 rpm (**photo 5**). The change is effected by taking the drive to the headstock either directly from the motor or from the countershaft. Belt tension is set by adjusting the idler roller. Also visible in these pictures is the safety switch interlock (coloured red) which prevents operation with the cover removed.

Traditionally, we are accustomed to seeing change wheel banjos which typically have two slides arranged in a Vee formation. Trust the Chinese to find a more cost effective design solution. Here the banjo is a straight component with a single slide to accommodate two moveable pivots. The selection of supplied metal 1.5 Module changewheels can be arranged to give 21 metric screw pitches from 0.2 to 3.5mm. A 63 tooth wheel is included and the manual also gives set ups for 21 imperial thread pitches ranging from 8 tpi down to 56 tpi.

Photograph 6 shows the control and switchgear layout on the headstock, a substantial casting, which carries the spindle in taper roller bearings. On the top surface is the emergency stop switch, and below this are located the start and stop push buttons, and the forward- off- reverse selector switch. On the upper section of the front face is the tachometer speed read out and then immediately below it, the rotary knob to select speed. There are then two selector knobs on the lower gearbox section, where the left hand determines the direction of feed, and the right hand gives one of three gear ratios



Lifting the lathe off the pallet using sling to take the weight and ratchet strap to level up.

for feed rate or screw pitch. These are significant changes compared to the WM240 machine, where feed direction was determined by moving a stud and gear in the changewheel train, and only one feed rate or screw pitch was available for one gear train set up. The central feature just below these knobs is a sight glass for gearbox oil level.

The spindle is bored through 26mm and has an internal nose taper of No. 4 Morse, so will accommodate one inch diameter bar. Chuck retention is by three nuts and studs, thus the machine can be run in reverse without the possibility of the chuck unscrewing.



Belt arrangement for low speed range.



High speed range belt arrangement. Inner belt is left in place driving idler pulley.



Controls on headstock.

Apron, Saddle and Cross Slide

A first glance at **photo 7** shows the expected handwheels for longitudinal and cross feeds and lever for engaging the clasp nuts for threading. The additional lever moves sideways then up or down to engage power feed, either longitudinal or cross feed. All handwheels are polished alloy, and are fitted with indexable dials.

Photograph 8 shows the graduated scales on the cross feed and longitudinal feed wheels. The cross slide leadscrew has a pitch of 2mm, and the divisions on the former are set for diametral rather than radial measurement. Thus one division gives a diameter change of 0.04mm or a radial shift of 0.02mm. One division on the longitudinal wheel equates to saddle movement of 0.25mm.

One notable design aspect is the Tee slotted cross slide. The slots are employed in the first instance to clamp down the top slide which may be rotated through 360 degrees. They also open up the possibility of undertaking milling operations. Maximum cross slide travel is 115mm.

Optional accessories include an adaptor plate and rear toolpost.

The top slide has a lead screw of 1mm pitch, and here, one division corresponds to 0.01mm of tool movement. It has a maximum travel of 70mm and, as standard, comes fitted with a four way tool post which has positive position indexing. Thus tools can be returned accurately to each working location.

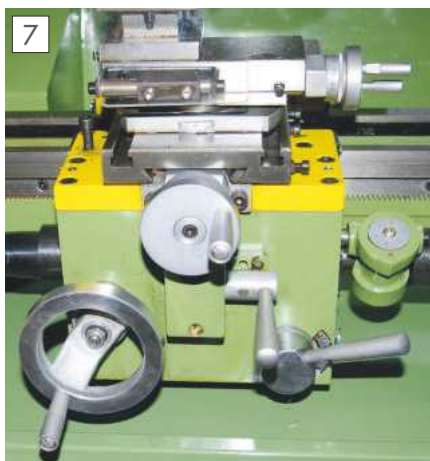
Tailstock

This carries a No 2 Morse taper barrel, giving travel of 80mm and has a lever lock and polished aluminium handwheel. The dial is indexable and graduated with divisions of 0.02mm. Provision is given to offset the centre for taper turning, with a scale to assist with returning to datum. **Photographs 9** and **10** show this section from front and rear.

Bed

The bed is a substantial casting of double Vee shape. **Photograph 11** gives a view of the cross section. The working surfaces are induction hardened and ground, and the length will admit 550mm between centres. On the rear of the bed are two flat mounting pads, intended to carry a purpose designed milling attachment available from Warco.

For milling work, it is likely that more accurate positioning of the saddle would be needed than can be achieved with the existing handwheel scale. Typically the



Saddle levers and handwheels.

solution would be a leadscrew handwheel, and given that the end of the leadscrew carries two adjustment ring nuts, it would probably be quite straightforward to substitute a threaded graduated wheel for the outermost nut. I raised the question of a factory supplied handwheel with Warco, which lead on to another conversation, and the offer of loan of the milling attachment to accompany the lathe.

Using the machine

The various controls come easily to hand and feel comfortable. All have good 'feel' with no undue tightness or slop. It does follow modern oriental practice in that the carriage handwheel is positioned to the left of the cross feed wheel in contrast to say Myford or Colchester, but this is rather similar to the way in which some cars have the indicator stalk on the left or right of the steering wheel. The E stop button is right on top and would be hard to miss in an emergency. In line with modern safety requirements you do need to have the change gear cover and the chuck guard in position or the interlocks prevent the motor from starting.

Speed is easily selected and read on the tacho so if you want to work at particular rpm, this is very straightforward.

As amateurs, we are not usually up against the clock when it comes to getting a job done, but it is nevertheless interesting to see how much metal can be removed in one go, so I took a series of cuts in a mild steel bar with progressively greater depth of cut. At 6mm the smooth cutting sound gave way to a more audible rasp then squeal. Close examination of the machined surface then showed fine tool vibration marks. So if you really do want



From this angle, the graduated scale and indexable dials are visible.

to munch metal quickly, you can certainly take about 5mm at a time.

The inclusion of power cross feed is a welcome addition. The saddle position can be locked using an Allen key, then the feed engaged to give a consistent facing finish. Cutting left hand threads on earlier Chinese machines typically required moving a gear in the changewheel train, but here, switching between left and right hand is accomplished by switching the feed direction knob.

For screw cutting, although a thread dial is fitted, given that we have an inverter drive with variable speed and easy switching between forward and reverse, my preference is to ignore the dial, and keep the clasp nuts engaged throughout the process. For me retracting the tool then reversing the machine works out about as fast as working out where to pick up, and is pretty well guaranteed to be error free.

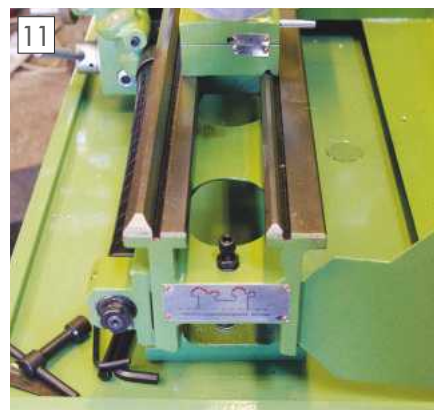
Given that this machine is reversible, and the chuck bolted on, parting off operations can be done by mounting an inverted tool in the front four way tool post, then running the machine in reverse. Alternatively an optional adaptor plate and rear tool post is available which then frees up one of the front tool positions. This toolpost and plate are substantial items with ground finish. The toolpost has an



Tailstock seen from front. Again, graduated and indexable handwheel.



Tailstock viewed from the rear, showing the locking lever.



End view of bed showing cross section, also plate confirming hardened and ground surfaces.

integral key in the base which engages with a slot in the adaptor plate, which is in turn bolted down to the cross slide Tee slots. Positioned correctly, the space between front and rear tools does become a little restricted so I chose to slide the base plate rearwards by about an inch as can be seen in **photo 12**. If we were engaged in production work, getting the tools close together could improve productivity – reducing slide travel, but nowadays I prefer a bit more finger room.

Milling in the lathe

Two rather different options are possible here. You can either place the cutter in a spindle mounted chuck, and the work on the optional vertical slide, or go the whole hog and fit the milling head designed to attach to the rear of the bed.



12 Rear toolpost and adaptor plate fitted, carrying a part off tool.

Vertical Slide

The former costs considerably less and offers travel of about 80mm vertically and 115mm horizontally. **Photograph 13** shows this robust unit mounted on the lathe. A ¼ inch throw away cutter has been gripped in the three jaw and a few light transverse cuts taken from a chunk of aluminium gripped in an old Myford chuck bolted to the vertical slide. My feeling was that for milling, better control of the longitudinal saddle position was needed than was afforded by the carriage handwheel and scale. My quick solution is described below.

Milling Attachment

Having always had the luxury of reasonable workshop space, I have never been drawn to the concept of combination machines. Since buying my first Myford in

the 70's, and shortly afterwards acquiring a Centec milling machine, I have been fortunate in enjoying individual machines for turning and milling functions. If we go back in history a little further, to the 50's and 60's, a milling attachment for a Myford was a popular add on, three types being pre-eminent – the Rodney, The Amolco, and the Staines. Of these the first and last were driven from the lathe headstock while the Amolco carried its own motor. The Warco attachment is similar in this respect and also benefits from variable spindle speed and other modern features. It is in essence a Warco WM14 mill supplied without the base and two axis table, but with a cast adaptor to fit to the rear of the lathe bed.

Photograph 14 gives a perspective view of the milling attachment fitted to the lathe. The topslide assembly has been



13 Topslide and rear toolpost removed and vertical slide fitted to the adaptor plate.



14 Milling attachment fitted to lathe permits larger work than the vertical slide.



15 Front view of milling head controls.

removed and a Warco DH1 vice bolted to the saddle, now milling table using the Tee slots. As an aside for those not familiar with the DH1, it has alternative and moveable jaws allowing it to grip work almost as large as its footprint.

The mill head carries a 2MT spindle and has a variable speed drive augmented by high (100 to 2250 rpm) and low (50 to 1125 rpm) gear settings. The inclusion of the gearbox allows the combination of low speed and high torque. The quill travel is 50 mm and it can be lowered either by the downfeed handles, or the fine feed wheel can be engaged. A digital read out of quill position is incorporated into the head.

Further vertical movement of about 210mm is possible by moving the head up or down the dovetailed column. Unlike a round column design, this ensures that registration is not lost when the head is moved. It is also possible to incline the head which could obviate the need for angular set ups on the table.

Photograph 15 gives a detail view of the head and its controls. Out of sight to the right hand side is the two speed gear change knob and the datum setting block for quick return to vertical. This block can be swung clear to allow the head to incline to the right. Morse tapers can be problematic if over enthusiastically tightened, then requiring a large hammer to release, with possible consequences for the spindle bearings. On this machine, the question is resolved by having a captive drawbar (**photo 16**). Undoing the bar causes it to bear on the retainer cap then eject the taper.

Test Drive

As a quick trial, I placed a piece of steel flat in the vice and a 10mm slot drill in the collet chuck, then inclined the head about 20 degrees. The cutter was then fed into the work to produce a sort of scallop shaped groove (**photo 17**). As noted above, I felt that for milling, the longitudinal feeding with the carriage wheel, was too coarse so looked for an "emergency" lead screw handwheel. My quick, dirty and somewhat rusty solution was to apply protective tape over the ring nuts, then clamp on a small four jaw chuck (**photo 18**). With the headstock drive to the leadscrew disengaged, this then made controlled feeding very easy. The question of a factory supplied handwheel has been raised, and would certainly be a welcome addition for milling work.

The next line of thinking was to power up both the mill and the lathe. Given that this lathe has power feed in both directions, three speed gear box and variable spindle speed, it becomes possible to arrange a milling set up then apply power feed to the saddle or cross slide, and vary the feed rate to suit the job.

Overall impression

In my earlier description of the WM240B lathe I drew comparisons with the Myford 7 series, however, while the footprint of this machine comparable to an ML7, its capabilities are several steps up in size, and it has so many of those modern features that make life easier and cleaner. The centre height being around five inches, take this machine more towards industrial size territory.



16
Captive drawbar ejects Morse taper without recourse to a hammer.

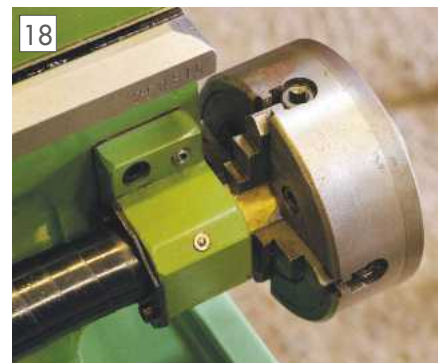
With the milling head fitted you really do have a pretty competent machining facility within a floor space of about four feet by two feet. While the milling 'table' is rather smaller than that on the WM14 machine, it should be ample for most model making work. If you do need to work on the end of a very long part, then it would be possible to remove the tailstock to give additional clearance.

My main criticism relates to the chuck guards required by modern safety legislation. I have to admit that I have never been a fan of these either on lathes or drills, particularly when they are electrically interlocked. Left to my own devices, I would certainly remove the milling cutter guard, which I feel gets in the way and obstructs the view. No doubt others with a more safety conscious outlook will disagree. If working with the milling attachment, I would certainly, in the absence of a commercially available item, exercise the grey cells and make a leadscrew handwheel.

Would I buy one? If I were starting out today, and equipping a new workshop, then the financial choice might be between the WM250V and a second hand Colchester Bantam, Chipmaster or similar. Pre owned machines usually have questionable provenance in industrial use, and even if mechanically good, are often in need of oil seals and electrical modification. Spare parts, are likely to be expensive, always assuming they are available.



17
Cutting a groove with the head inclined.



18
Jury rigged leadscrew handwheel gives control for milling feed.

Conversely, the new machine may lack time savers such as Camloc chuck fitting and full thread cutting gearbox, but it does come with a year's warranty, out of the box ready to plug and play with absolutely unworn slideways and many of the built in features that not long ago were either optional extras or just not readily available. There are a number of slideway oiling points, and a pressure oil can is supplied. Taken in conjunction with the hardened and ground bedways, this machine is likely to retain its accuracy over a long life.

Looking back at my own workshop progression, I moved up to a Colchester Bantam when work started on a 7 1/4 gauge loco. A WM 250V would have been able to handle those components. ■

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The author's challenger lathe.



Challenge and Response

Stuart Walker offers some thoughts provoked by a recent article on the Challenger Lathe.

I read Jon Freeman's article with interest. It's seldom that articles appear about the Chester Challenger lathes and as a fellow user (**photo 1**), I thought it might be helpful for anyone contemplating the purchase of one of these versatile '1440' lathes to hear a slightly different perspective.

These are robust and well respected lathes that are comparable to the older Colchester and Harrison work horses that were commonly found in technical colleges and industrial workshops. There is little doubt that the old British made Colchester and Harrison machines were superior in build quality, and this is reflected in the price of these lathes on the used market, often selling for more than a new 1440. However, if you're looking for a good lathe to machine the many different parts for the larger models such as 3 or 4 inch scale traction engines or 7¼ inch gauge locomotives, I believe you'll not be disappointed if you use a 1440 lathe.

I purchased my Challenger after looking at several different options and have no reason to regret my choice, as it can easily accommodate the large castings as

well as the small and delicate components.

Warco also market the same type of 1440 lathe which my friend, Paul Gammon, has been using to advantage for a similar number of years. Not having a 415 volt 3 phase supply in his shop, he exchanged the standard 2 speed motor for a single speed 220 volt 3 phase unit and powers it with a single phase inverter, which provides the same power output as well as a variable speed facility. Whilst I have experienced no particular difficulties with the standard two speed motor, the inverter driven version does undoubtedly offer an improved speed range, as well as avoiding the expense of installing a 3 phase supply. Paul is a retired professional tool maker and well respected model engineer who gave me sound advice, including guidance on the following modifications which have helped make the lathe a joy to use (**photo 2**):



Turning the rim of a model traction engine wheel.



New arrangement for front panels.

Jon's suggested method of adjusting chuck runout no doubt suits his method of work, but I feel it should just be pointed out that good practice requires that the cam locks are tightened on the taper to the point where the spindle flange makes full contact with the chuck flange.

Provide a large contained tool tray on top of the headstock and full length shelving along the back wall for the tooling.

Make new long handled chuck and cam lock keys (using EN 24T) to provide a more comfortable reach into the confined spaces.

Cut an opening to allow front access to the coolant system and plate up the existing back entry to retain the base rigidity.

Make useful full depth storage shelving above the very useful foot brake and under the removable swarf tray with a simple lift latch front panel (**photo 3**).

Provide a bench height shelf abutting the tailstock end of the lathe faced with galvanised sheet for parking chucks and large size drills.

Improve the coolant plumbing from the swarf tray to the reservoir tank and provide a fine swarf filter. Also, use a

domestic fish tank air pump and small plastic diffusers to keep the coolant fresh and avoid the growth of bacteria with its resultant unpleasant smell.

Make a new counterbalanced chuck and splash guard system that can slide along parallel to the work and stop any flying swarf and splashing coolant from going up the wall. Also provide a movable front guard to prevent flying swarf and coolant splashing over the floor (**photo 4**).

Move the coolant delivery pipe and light support base, mounted on the back of the saddle, by inserting a spacer block to allow more clearance for manoeuvring the tailstock (**photo 5**). Recently, the original light has been replaced with a more useful swan neck version.

Fit a direct reading DRO to the tailstock and add front bed slide wipers (**photo 6**).



Challenger lathe taking first test cuts using coolant with splash guard working well.

Provide the saddle clamp lever with a swing stop to ensure it doesn't inadvertently get trapped when the tailstock is moved up to the work.

Fit a pair of additional gears that can be easily engaged to achieve a very slow feed rate when an improved machine finish is needed (**photos 7 & 8**).



Challenger lathe showing redesigned front access, coolant plumbing and bottom shelf.



Challenger lathe tailstock fitted with front stop digital readout and swarf protection ring.



Challenger lathe being used to turn the 11 inch diameter final drive gear blanks.



The slow feed gears 2.



The completed topside front view.



The completed topside back view.



Challenger Lathe with all modifications complete.



The 5C collet chuck.

Make up a new topside with magnetic strip DRO and slow speed power feed for machining Morse and other short tapers (**photos 9 & 10**). Details of this can be found on the new SMEE website.

The lathe with all modifications is shown in **photo 11**.

Jon's suggested method of adjusting chuck runout no doubt suits his method of work, but I feel it should just be pointed out that good practice requires

that the cam locks are tightened on the taper to the point where the spindle flange makes full contact with the chuck flange. This is required to ensure rigidity and consistency. I agree the standard 8 inch chuck has its limitations for holding small work, but it's not recommended practice to mount a small chuck in a larger one because it poses runout issues and speed limitations. There is a wide range of alternative chucks and D14

backing plates available and I've found the following to be useful additions: 5 inch 3 jaw and 4 jaw self-centring chucks, along with a 5C collet chuck (**photo 12**). The standard 8 inch 4 jaw also has its limitations and both 6 inch and 10 inch versions are also useful additions. The standard 12 inch diameter faceplate clears the bed with ease and if the gap plate in the bed is removed, a 19 inch version can be used. ■

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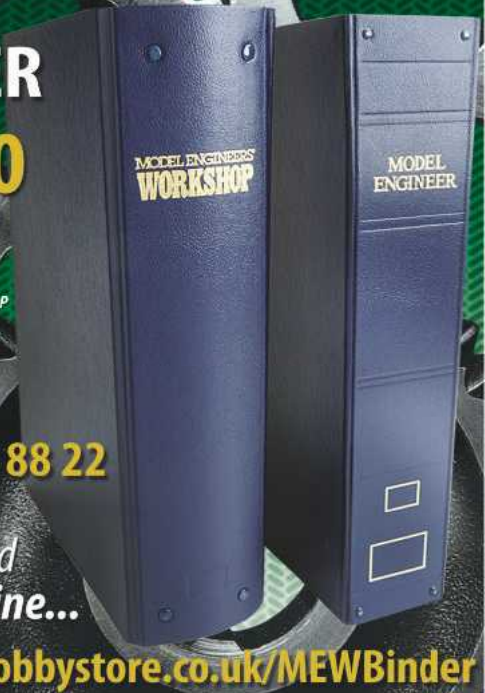
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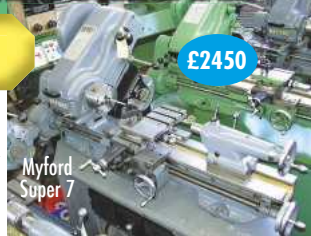
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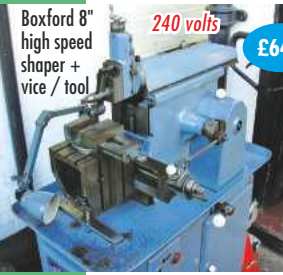
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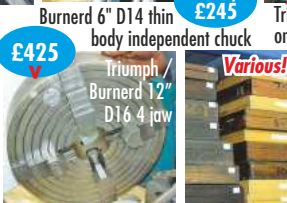
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